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**Groundwork for Developing and Implementing the Lead User Method
for Redesigning a Media Based Teaching and Learning Service**

Thesis submitted in partial fulfillment of the requirements for the degree of Master of
Science in Technology

Espoo, June 2, 2010

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Title of the thesis:	Groundwork for Developing and Implementing the Lead User Method for Redesigning a Media Based Teaching and Learning Service		
Date:	June 2, 2010	Number of pages:	67+5
Faculty:	Faculty of Engineering and Architecture		
Department:	Department of Engineering Design and Production		
Professorship:	Kon-41 Machine Design		
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<p>Users have an increasingly important role in product development. The more commonly used approaches rely on gathering information from the users in the target market. User innovation is an innovation already developed by a user or users, thus bypassing the chance for misinterpreting the user information when transforming it into products. Lead users are users who face needs before the majority of the market and benefit significantly from obtaining solutions to those needs. The lead user method aims to bring knowledge and skills of lead users into product development. Some of the strengths of the lead user method are the possibility of overcoming the problem of functional fixedness, the possibility of finding solutions from analogous areas and the efficiency of developing breakthrough products. The main question of the method is how to find lead users.</p> <p>Benchmarking is an approach sharing the mindset with the lead user approach: finding solutions from outside. Benchmarking aims to do this by comparing and adopting the best solutions in the field. Both approaches also share some crucial characteristics such as the first steps of the processes and the possibilities of analogous areas.</p> <p>The main goal of this study was to discover or develop a method for breaking a product or service into elements. These elements are to be used as a foundation for implementing the lead user method, which is supported by benchmarking, in the development of an existing product or service. The second goal was to consider the possibilities of the lead user method and benchmarking supporting each other through the method presented in this study.</p> <p>A Participatory 3D modeling method (P3D) was developed for breaking a product or service into elements. The empiric evidence of the performance of the method was collected in two P3D workshops: one for the users of a media based teaching and learning service, and one for the designers of the service. The method proved its excellence in breaking down the service and capturing the complete perceptions of the service of both the users and the designers. However, the results of the method were not completely usable. Some effort was required in transforming the results into a suitable form for using them as a foundation for the lead user method and benchmarking. This study also proposes possible ways for the further development of the P3D method.</p> <p>In regards to the second goal, an integrated approach was proposed. The approach combines the strengths of both the lead user method and benchmarking by combining some of the common methods used, when implementing the approaches. The integrated approach uses the results of the perfected P3D method as a foundation, when using it in improving existing products or services. The possibilities of the approaches supporting each other are promising.</p>			
Keywords:	lead users, user innovation, benchmarking, product development, participatory design, participatory 3D modeling, generative tools		

Acknowledgements

I want to thank Researcher Pia Helminen for guidance, inspiration and all the valuable insights through the whole process of writing this thesis. I also want to thank Research Manager Matti Hämäläinen for bringing his vision and ideas into our discussions.

I am grateful for my superior at BIT Research Centre, Research Manager Lauri Repokari, and Head of Education and Science Tapio Kujala of YLE, for making everything possible. I am also grateful for Leila Haltia, Raimo Lång, Mika Salomaa, Marja Paavilainen and Jukka-Pekka Heiskanen for sharing thoughts, and for creating a meaningful and participating atmosphere for the team.

I also want to thank Professor Kalevi Ekman for introducing me the world of product development in an inspiring way, and for supervising and guiding the writing of this thesis. I am also grateful for him, as well as all the other individuals behind the realization of Design Factory, for creating a wonderful working environment and co-creation platform.

Special thanks for my family and friends for putting up with me – especially for Maria for all the support, encouragement and tolerance.

Design Factory, Otaniemi, Espoo

June 2, 2010

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1 Introduction

It has been broadly acknowledged that users have an increasingly important role in successful product development. The terminology around user involvement is wide and correspondingly, so is the range of possible ways of involving the user. The more traditional approaches, such as interviews and observations, rely on gathering user information from the target market. However, the acquired information still has to be transformed into products.

Forecasting the demands of the future using traditional methods can be a difficult task. The lead user method, introduced by von Hippel¹, takes a different approach. Lead users are users who face needs before the bulk of a market and benefit significantly of developing solutions to those newly discovered needs.

The lead user method has several strengths. The method has the possibility of overcoming an effect called *functional fixedness*, which blocks one from finding truly novel ideas^{2,3}. For example, a person who sees a paper clip attached to papers is less likely to unbend the paper clip for using it as a wire compared to someone who sees the paper clip loose⁴. Lead users, however, already live in the future conditions and are free of the boundaries set by previous related experiences⁵. Therefore they are more able to come up with novel solutions, thus being very appealing to product development.

Another important characteristic of the method is the possibility of finding solutions from *analogous fields* – outside the target market. Antilock braking system (ABS) was an innovation made in the field of aerospace⁶. Today, it is used in normal cars around the globe.

The lead user method is efficient in creating *breakthrough products*, which is also the area on which most of the research literature of the topic emphasizes on. Lead users can be found from various places and in various forms. The main question of the method is: how to find lead users? There are various, but yet similar, processes for finding lead

¹ von Hippel 1986

² Duncker 1945

³ Adamson 1952

⁴ Duncker 1945

⁵ von Hippel 1986

⁶ von Hippel, Thomke & Sonnak 1999

users. These processes are modified according to the needs of any particular case. In the case presented in this study, the lead user method is implemented in redesigning an existing service. However, important groundwork is required before the actual implementation of the modified lead user process.

This master's thesis is done as a part of a project called Innopé, funded by Yleisradio Oy (YLE) – the Finnish Broadcasting Company. YLE comprises four television channels and Text-TV, 26 radio channels and an online service yle.fi which also provides mobile services.

The Innopé project is conducted in cooperation with YLE, BIT Research Centre (BIT) and Aalto University Design Factory (DF). The project team comprises, in addition to the author, the following persons from YLE: Project Manager Leila Haltia, Development Director Raimo Lång, Head of Education and Science Tapio Kujala, Executive Producer Mika Salomaa, Executive Producer Marja Paavilainen, Deputy Head of Education and Science Jukka-Pekka Heiskanen, and from BIT/DF: Research Manager Lauri Repokari, Research Manager Matti Hämäläinen and Researcher Pia Helminen. Most of the project input results from the work of Pia Helminen and the author, supported and guided by the team members at BIT/DF and by the regular meetings with the whole team.

A to-be-published article of Helminen et al.⁷, resulting from the Innopé project, presents some of the results and discussion presented also in this study. Those results and resulting discussion are not separately referenced after this introduction chapter.

Opettaja.tv is a service for teachers both on television and online. YLE Teema, one of YLE's television channels, broadcasts Opettaja.tv for a few hours five days a week offering teaching material for teachers to use in class as well as education material for teachers' further education and further development. Most of the broadcasted material is also available online. The website offers audiovisual teaching material and tools for class. It also acts as a discussion forum and as a teaching material exchange platform for teachers.

⁷ Helminen, Hämäläinen & Mäkinen 2010

The Innope project has two main goals:

- a. To develop a concept of a new Opettaja.tv based mainly on the implementation of the lead user methodology, supported by benchmarking
- b. To provide YLE with a generic lead user model

The project consists of three partially concurrent main phases illustrated in Figure 1. This study is situated on the beginning of the project, covering a part of both *benchmarking* and *identifying lead users*.

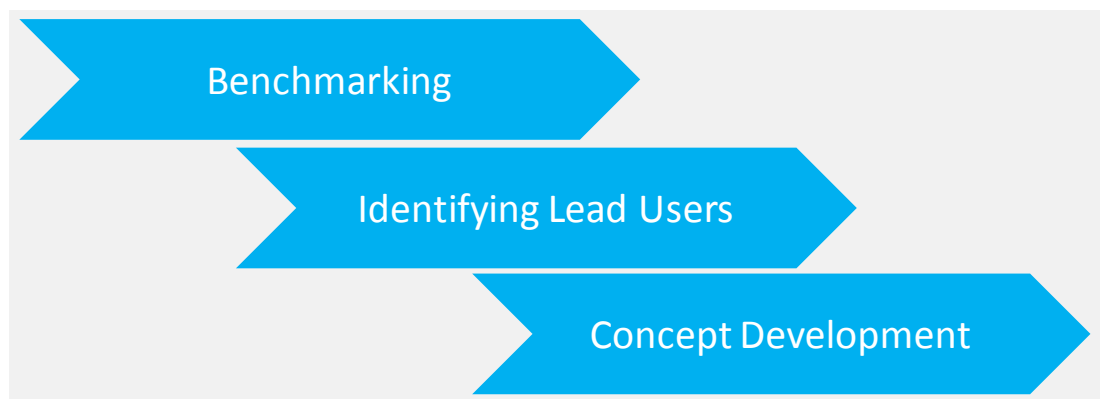


Figure 1 The main phases of the Innope project

The main goal of this study is to discover or develop a method for breaking a product or service into elements. These elements are to be used as a foundation for implementing the lead user method, which is supported by benchmarking, in the development of an existing product or service.

Achieving the goal demands understanding of the lead user theory and it will have the most emphasis in the literature review of the study. Also, the connection between the lead user method, user innovation and product development will be explained. A sneak-peak into the user-centred product design and development will be taken in order to understand this connection.

Another broad part of the literature reviewed dives into the sources of inspiration in developing the solution for achieving the main goal of the study. The review presents several approaches and methods grasping the basic idea behind them, and bringing the

mindset of them for the use of this study, going into details only when those details can be brought to help achieve the goal.

The phase of the generic lead user process which follows the implementation of the method developed in this study will be examined in order to better understand the requirements for the needed solution, even though the methods examined there are not a part of methodology used in this study. This is also required for creating the big picture and positioning the developed method seamlessly into the process of creating a new concept of an existing product or service by implementing the lead user method.

Benchmarking is another approach, which is also used in the Innope project. It is an approach sharing the mindset with the lead user approach: finding solutions from outside. Benchmarking aims to do this by comparing and adopting the best solutions in the field. Both approaches also share some crucial characteristics such as the first steps of the processes and the possibilities of analogous areas.

The second goal of this study is to consider the possibilities of the lead user method and benchmarking, supporting each other through the method presented in the study. A possibility of combining the approaches even further will be looked into, as the results of method developed here act as groundwork for both lead user method and benchmarking. The approaches and the methods around them will be explained, concentrating on their shared characteristics. The method developed for the main goal of this study, combines the first phases of the two approaches and these phases will have the most emphasis.

This chapter has provided an introduction to the thesis by introducing some background of the research fields and interested parties, as well as the scope and the goals of the study.

Chapter 2 introduces the fields of product development, user innovation and lead user methodology. It presents the main idea behind all of them and continues into details only when required considering the scope and goals of the study. The chapter links the three topics together.

Chapter 3 presents the sources of inspiration for the *Participatory 3D modeling method* (P3D) which was developed to achieve the main goal of the study. It also provides a

review on benchmarking enabling the consideration of the possibilities of the lead user method and benchmarking supporting each other – which is the second goal of the thesis.

Chapter 4 describes the methodology used in gathering the empiric evidence of the study. It begins by explaining the differences between the two approaches which are used for achieving the main goal of the thesis. The main goal is discovering or developing a method for breaking a product or service into elements. These elements are to be used as a foundation for implementing the lead user method, which is supported by benchmarking, in the development of an existing product or service. The chapter goes through both approaches in detailed manner and justifies the development of the Participatory 3D modeling method.

Chapter 5 presents the results of both approaches that are described in the fourth chapter. The chapter further justifies the creation of P3D method and builds a foundation for the discussion in the following, sixth, chapter.

Chapter 6 evaluates the performance and suitability of the P3D method and proposes possible ways for developing the method further. It also considers the suitability of the lead user method in redesigning Opettaja.tv. The chapter also introduces an integrated approach combining the strengths of the lead user method and benchmarking and discusses the possibilities of the approach.

2 User Innovation in Product Development

2.1 Product Development

Ulrich & Eppinger⁸ define product development as a *set of activities beginning with the perception of a market opportunity and ending in the production, sale and delivery of the product*. The generic product development process introduced is illustrated in Figure 2.

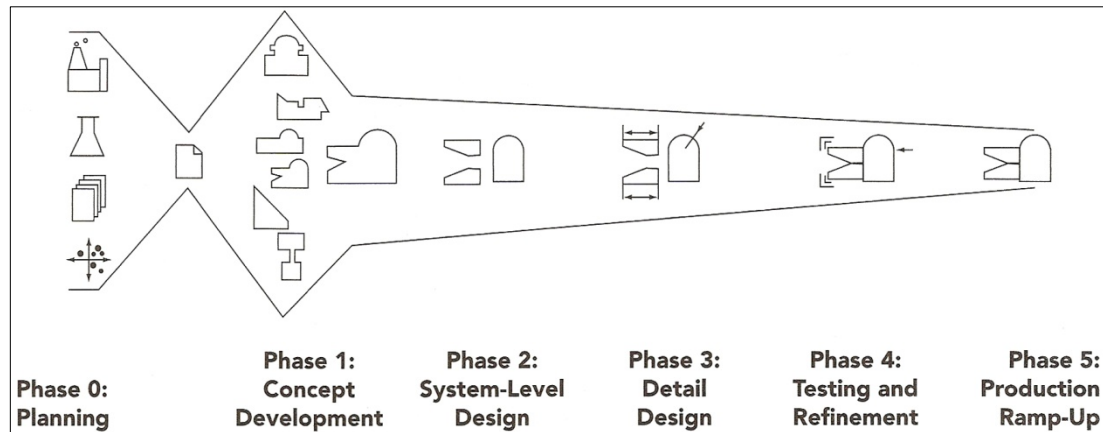


Figure 2 The generic product development process⁹

Otto & Wood examine product development in process level where they see design process as an internal process to product development process. According to their definition, product development process is *the entire set of activities required to bring a new concept to a state of market readiness*. A design process is *the entire set of technical activities within a product development process that work to meet the marketing and business case vision*. Manufacturing is a separate process and depending on the industry, so is the Research and Development (R&D) which is about developing new technology to be incorporated into products. However, the design of the manufacturing process is considered as a part of the product development process and when it is carried out simultaneously with the design process, the integration is called *concurrent engineering*.¹⁰

The product development process can be seen as a sequence of parallel and serial activities to be completed. The process is called *stage-gate process* or *waterfall*

⁸ Ulrich & Eppinger 2008

⁹ Ulrich & Eppinger 2008

¹⁰ Otto & Wood 2001

development process which consists of phases and gates that follow each phase. Each gate acts as a point where the upper management or the development team can evaluate whether the next stage is worth carrying forward.¹¹

When venturing into the wide range of literature on product development, it is easy to agree with the notion of Otto & Wood that every product development process is different and depends on the technological and market environment of a company.¹²

Also Ulrich & Eppinger point out that the development process employed by a specific company may differ from the generic process illustrated in Figure 2. The generic process is most likely the one used in a market-pull situation where a company begins product development with a market opportunity and then uses the technology available in satisfying the market need. Other types of situations, such as technology-push or platform products, require variants of the generic process.¹³

Users have an increasingly important role in product and service development. The terminology around user involvement is wide. Correspondingly, so is the amount of possible ways of involving the users. However, the end-user is not necessarily the one who makes the purchasing decision. For example, the one who installs the connector on power lines in mid-air several meters from the ground, is probably installing a product his employer has bought. The company owning the power lines is keen to have a minimal energy loss – possibly at the expense of some other feature. In a simple situation like this we have various stakeholders; someone interested on the price of the connector, someone interested on the ease of the installation and someone interested on the efficiency. Hyysalo lists three forms of information that should be taken into account when developing new products, including market information, customer information and user information, of which user information helps connecting market and customer information¹⁴.

Acquiring user information is essential when moving from research-driven innovation towards user-driven innovation. User information can be utilized throughout the whole product development process and there are several methods for gathering different types

¹¹ Otto & Wood 2001

¹² Otto & Wood 2001

¹³ Ulrich & Eppinger 2008

¹⁴ Hyysalo 2006

of user information, including observing, interviewing or artifact analyses, for example¹⁵. However, after gathering the information, the developers still have to successfully transform the acquired information into products.

The lead user method is one possible method for involving the users in product development. User innovation is an innovation already developed by a user or users, thus bypassing the chance for misinterpreting the user information when transforming it into products. Lead users might have already gone through nearly the whole product development process while obtaining a solution for a need he or she faced. The next two chapters introduce the phenomena of user innovation and lead users.

2.2 User Innovation

What do post-it notes, mountain bikes, World Wide Web and ABS brakes have in common? The answer is user innovation. Lead users have had a significant role in the development of all these solutions – or in other words, user innovations.

Mountain bikes have been in the market, available for anyone who can afford it, since 1980's. However, mountain bikes have existed already in early 1970's. The origins of mountain bikes are in California where a group of friends were riding their bikes in rocky trails nearby Mt. Tamalpais. In 1970's, while riding on those trails, Joe Breeze recognized a demand for fat tires, different types of brakes and a lighter frame. Until that point they had been using balloon-tire one-speed bicycles with coaster brakes. The need for new brakes for example was caused by descents in the surroundings of Mt. Tamalpais that caused the coaster brakes to overheat, leading in repacking the brakes. Those bikes, developed by the riders themselves to satisfy riders' new needs, were referred as "my mountain bike" in contrast to "my road bike".¹⁶

These bikers were *lead users*, and what they developed was a *user innovation*.

Today, mountain bikes are manufactured by several companies and there is a variety of different brands from where customers can choose from – Breezer¹⁷, after Joe Breeze, being one of the brands. There was clearly a gap in the market – a need for mountain

¹⁵ Hyysalo 2006

¹⁶ Brandt 2006

¹⁷ Breezer 2010

bikes. What if a company, systematically trying to find these lead users, would have found them and would have developed mountain bikes with those lead users? The company would have gained a massive head start over its competitors. Combining this notion with the fact that from 10 % to nearly 40 % of users engage in developing or modifying products¹⁸, it is difficult to avoid the conclusion that lead users might be a valuable asset.

Rogers¹⁹ defines a diffusion of innovations as *a process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among the members of the social system*. According to the diffusion model, an innovation is diffused when it has been adopted by 100 % of the members of a system. Rogers divides the adopters into five categories: *innovators*, *early adopters*, *early majority*, *late majority* and *laggards*, as also illustrated in Figure 3:

Innovators: Venturesome

The first 2.5 % adopting new technology. Innovators play an important gatekeeping role in the flow of new ideas, importing innovation from outside of the system's boundaries with the help of their cosmopolite social relationships. They are able to cope with uncertainty and accept occasional setbacks when new ideas prove unsuccessful. Their venturesomeness is almost an obsession.

Early Adopters: Respect

The next 13.5 % form an adopter category having the highest degree of opinion leadership in most systems. Early adopters are often considered as "the individuals to check with" before adopting a new idea. They are respected and potential adopters look for advice and information from them. They help trigger the critical mass in adopting an innovation.

Early Majority: Deliberate

The next 34 %, forming one third of all members in the system, adopt new ideas just before the average member. The early majority may deliberate some time before adopting new idea, resulting in relatively longer innovation-decision period than the

¹⁸ Lüthje & Herstatt 2004

¹⁹ Rogers 2003

innovators and the early adopters have. A position of opinion leadership is rare among them.

Late Majority: Skeptical

The next 34 % approach innovations with skepticism and peer pressure is necessary to motivate adoption, although late majority still will not adopt until most others in their system have done so. Most uncertainty must be removed before they feel it is safe to adopt.

Laggards: Traditional

The last 16 % in adopting an innovation possess almost no opinion leadership and many are isolates in their system's social networks. For laggards, the point of reference is the past. They are often suspicious towards innovations although their resistance might be entirely rational as they might have limited resources and they want to be certain that the new idea will not fail.²⁰

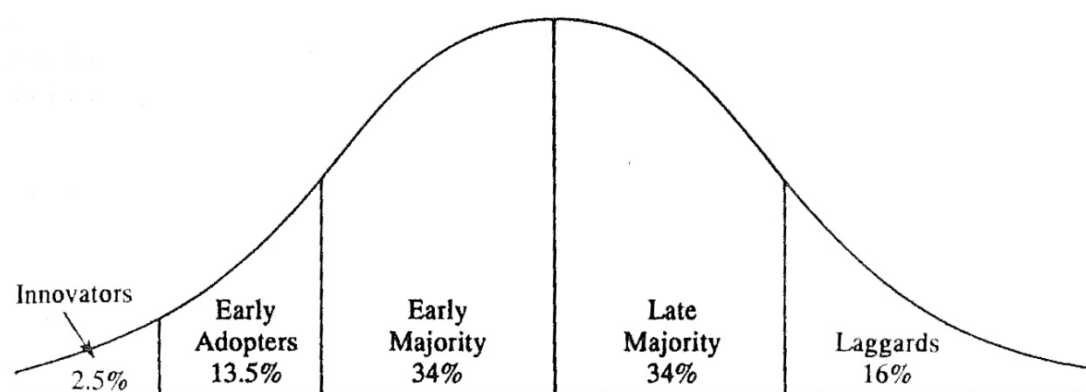


Figure 3 Rogers's adoption curve

When introducing the term lead user in 1986, von Hippel²¹ defined lead users of a novel or enhanced product, process or service as those displaying two characteristics with respect to it:

²⁰ Rogers 2003

²¹ von Hippel 1986

1. *Lead users face needs that will be general in a marketplace – but face them months or years before the bulk of that marketplace encounters them.*
2. *Lead users are positioned to benefit significantly by obtaining a solution to those needs.*

In the previously described case of mountain bikes, the bikers faced a need to which current market offerings could not answer. They possessed the understanding and skills to create solutions of their own to answer those new needs. Benefits were high enough to encounter the required effort of developing the solutions which led to the creation of user innovation, mountain bikes.

As stated by Von Hippel, lead users are ahead of the entire adoption curve – they experience needs before commercial products exist and often end up developing their own solutions²². The term *innovator* in Rogers' diffusion model²³ is a bit misleading since, according to the model, innovators are *adopting* new technology instead of *creating* solutions of their own. The position of lead users ahead of the five categories of Rogers' diffusion model is illustrated in Figure 4.

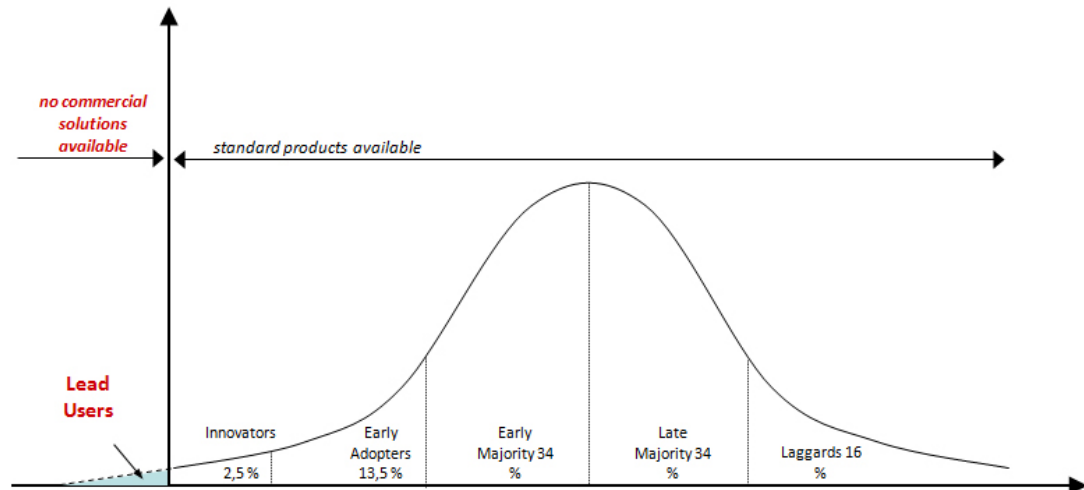


Figure 4 Lead users' position ahead of the entire adoption curve²⁴

It is important to note that lead user is not necessarily a person but can also be a manufacturer. User expects to benefit from *using* a product or a service while

²² von Hippel 2007

²³ Rogers 2003

²⁴ Helminen 2008

manufacturer expects to benefit from *selling* a product or service. Boeing for example is a manufacturer of airplanes, but it is also a user of machine tools. Airplane related innovations by Boeing are considered as *manufacturer innovations*, but metal-forming machinery innovations created by Boeing for developing airplanes, would be categorized as *user innovations*.²⁵

An interesting and controversial example of making use of the skills of lead users is provided by a console and PC games developer company called Ubisoft. After releasing an update patch online for one their hit games, some of the users who installed the patch, were not able to play the game they had purchased earlier. The company was asked to fix the problem in several threads of the company's online forum and it was pointed out by the gamers that an illegal crack, developed by users, can fix the problem. The crack's original purpose was to allow the gamers to play the game without the physical media. The moderators at the Ubisoft forums warned anyone suggesting the crack, that the crack is unofficial and illegal and such suggestions would not be tolerated. Later, during the same day when the original malfunctioning patch was released, Ubisoft released the illegal crack as a part of their new official update that would fix the problem. The content of the new official patch was revealed, again, by the users running the patch through an editor.²⁶

Lead user approach offers several benefits which help understanding the increasing popularity of the approach.

Lilien et al. report on experiment conducted within 3M Company on the performance of the lead user method compared to more traditional methods, which collect information from the users at the centre of the target market. They found that non lead user methods produce mainly improvements and extensions to existing product lines while the lead user method resulted in more ideas for completely new product lines. Estimation for annual sales after five years showed that lead user ideas will have eight times higher sales than the ideas produced with traditional methods.²⁷

²⁵ von Hippel 2005

²⁶ Afterdawn Oy 2010

²⁷ Lilien, Morrison, Searls, Sonnack & von Hippel 2002

Franke et al. studied relatively young and trendy field of kite surfing. Kite surfing is a water sport in which the user stands on a surfboard like board pulled by a large steerable kite. The kite can lift the user several meters from the water allowing them to perform tricks in the air or try to hang in mid-air as long as possible. The study analyses *the relationship between the commercial attractiveness of innovations developed by users and the intensity of the lead user characteristics embodied in those users*. Their findings are illustrated in Figure 5. When moving from low to high benefit, the proportion of innovating users rises. Similarly, when moving towards the position in ahead of a trend, the attractiveness of innovations rises. They also found out that *a single component of the lead-user definition - being at the leading edge of a marketplace trend - predicts both user innovation likelihood and innovation attractiveness*.²⁸

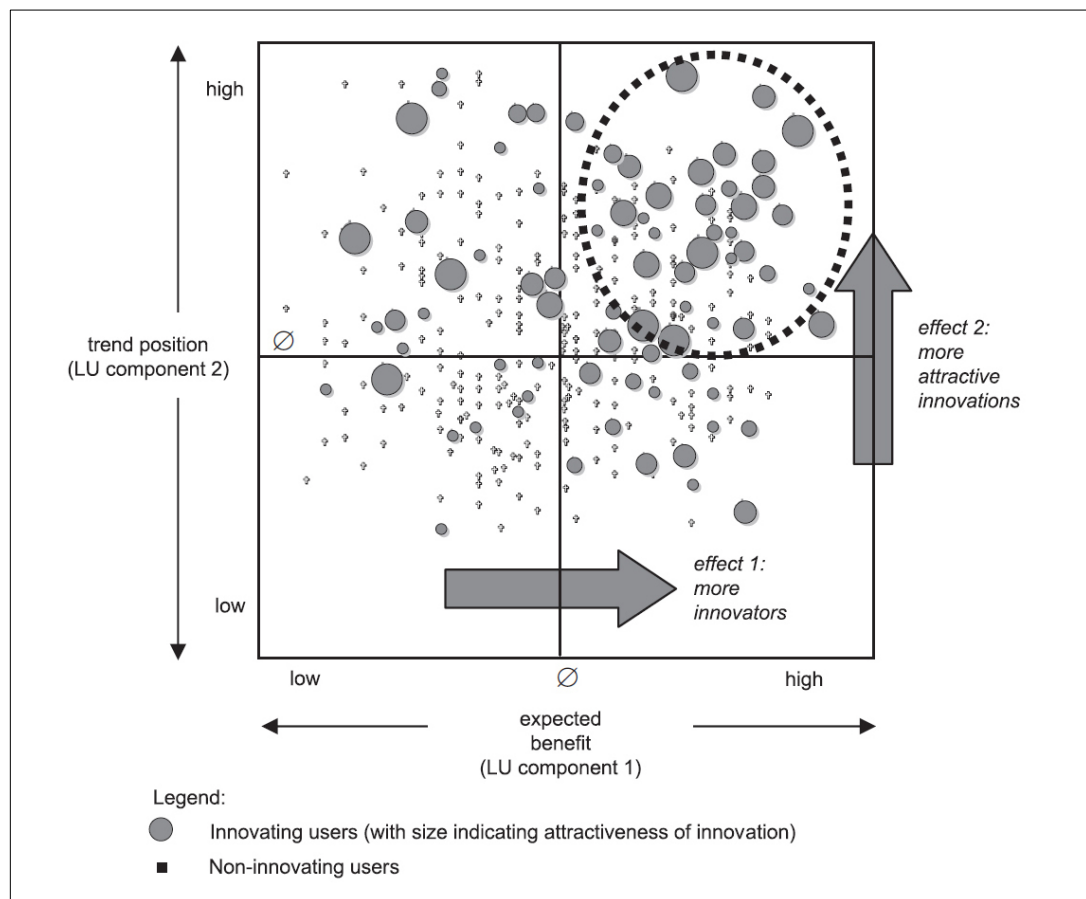


Figure 5 The effect of the lead user characteristics on the attractiveness of lead user innovations and on the proportion of innovating users²⁹

²⁸ Franke, von Hippel & Schreier 2006

²⁹ Franke, von Hippel & Schreier 2006

The attractiveness of lead user developed concepts was also noted by Urban & von Hippel when measuring the attractiveness of printed circuit CAD systems developed by lead users.³⁰

Favorable results came also from the study of Franke & Hippel concerning *user innovation toolkits* where they found out that users provided with a toolkit to modify Apache web server software, according to users' own needs, were more satisfied compared to the users who were unable to modify it³¹. An example of user innovation toolkit would be Apple's software development kit (SDK) that allows users to create applications for their iPhones or other Apple's products³². Considering that iPhone is an application centered product, creating applications can be considered as modifying the product.

User innovation toolkits are better suited for satisfying heterogeneous user needs when it would be expensive for a company to make a variety of products satisfying every need. Providing toolkits for users allows the company to develop a product satisfying most needs and leaving further customization to the users themselves.³³

Yet another addition to the strengths of the lead user method is the possibility to overcome an effect called *functional fixedness*. Research into classical problem solving literature shows that person's innovative potential is bound to the previous related experiences. This effect, functional fixedness, blocks one from finding novel ideas. For example, a person who sees a paper clip attached to papers is less likely to unbend the paper clip for using it as a wire compared to someone who sees the paper clip loose.^{34,35}

Also, the more recently an object has been used in a familiar way, the harder it is for one to use it in a novel way³⁶. When individuals are constrained by their past experience, they are able to find solutions only from their own solution space. Although functional fixedness might affect also the persons at the leading edge, their constraints are lower

³⁰ Urban & von Hippel 1988

³¹ Franke & von Hippel 2003

³² Apple Inc. 2010

³³ Franke & von Hippel 2003

³⁴ Duncker 1945

³⁵ Adamson 1952

³⁶ Adamson & Taylor 1954

since they already live in the future conditions³⁷. The ability of lead users to overcome the effects of functional fixedness increases the value of the lead user approach. The concept of finding solutions from where one would not expect to search or find them is close to the idea of analogous areas as sources of user innovations.

Analogies are closely related to the main question of the lead user theory: how to find lead users? In search for lead users and user innovations, von Hippel introduces the possibilities of analogous fields with an example of a manufacturer developing centralized controller for home heating, lighting and security systems. The manufacturer might as well try to identify lead users among firms who are offering similar controllers with similar functions to commercial buildings. He further elaborates the example with an option for the manufacturer to search lead users with respect to only few or even single attribute. In this case the attribute could be energy saving and the lead users could be sought from industrial applications where energy consumption or costs are high.³⁸

Lead users can also be identified from advanced analog fields. A car manufacturer aiming to design an innovative braking system could begin the search for lead users amongst the groups who have a strong need for better brakes, such as racing teams. They also could venture into a really advanced field where people have even greater need to be able to stop quickly, such as aerospace. It actually happens to be that innovations such as antilock braking systems (ABS) were first developed in the field of aerospace. Military aircraft commands are highly motivated to develop solutions which allow their expensive vehicles to stop before they run out of highway.³⁹

Sometimes the problem solving activities of lead users take the form of applying existing commercial products in ways not anticipated by their manufacturers⁴⁰. Although the inspiration for ABS was found from the analogous field of aerospace, the concept behind ABS could also have been learned from auto racing teams where lead users had learned to manually pump their brakes⁴¹.

³⁷ von Hippel 1986

³⁸ von Hippel 1986

³⁹ von Hippel, Thomke & Sonnak 1999

⁴⁰ von Hippel 1986

⁴¹ von Hippel 2005

Disabled or situationally disabled users might be a valuable source as well. A blind person for example has very different needs for a mobile phone compared to ordinary users needs. Innovations made by these extraordinary users benefit ordinary users as well and they can be considered lead users. If something performs better, it is likely that ordinary users will like it too. Ordinary user might be situationally disabled for example when in a dark room or when driving a car, thus being unable to see normally or use hands properly.⁴²

Positional lead user is someone who fulfills his or her needs with by-features of an artifact or assets originally intended for something else⁴³. An example of this would be using the light of a mobile phone's screen as a primary source of light⁴⁴.

As pointed out in this chapter, lead user approach has several strengths explaining the wide interest around the topic. It was also shown that lead users can be found from various places in various forms, which also speaks on behalf of the diversity of possible solutions found with them. The lead user approach can be used in developing improvements to existing products but the approach really does justice to itself when aiming for breakthrough products. The following chapter introduces some of the methodology behind the approach and gives answers to the main question of the approach: how to find lead users?

2.3 Lead User Methodology

In 1986, von Hippel introduced a four step process for incorporating the lead users into marketing research: (1) *identify an important market or technical trend*, (2) *identify lead users who lead that trend in terms of (a) experience and (b) intensity of need*, (3) *analyze lead user need data*, and (4) *project lead user data onto the general market of interest*.⁴⁵

In 1988, the lead user process was refined into more general form by Urban & von Hippel⁴⁶:

⁴² Hannukainen & Hölttä-Otto 2006

⁴³ Tuulenmäki & Helminen 2009

⁴⁴ Hannukainen 2005

⁴⁵ von Hippel 1986

⁴⁶ Urban & von Hippel 1988

1. Specify lead user indicators

A. Find market or technological trend and related measures

Lead users are defined as being in advance of the market with respect to a given important dimension which is changing over time. Therefore, before one can identify lead users in a given product category of interest, one must specify the underlying trend on which these users have a leading position, and must specify reliable measures of that trend.

B. Define measures of potential benefit

High expected benefit from solving a need is the second indicator of a lead user, and measures or proxy measures of this variable must also be defined. In work to date, we have found three types of proxy measures to be useful. First, evidence of user product development or product modification can serve as a proxy for user benefit because, as we noted previously, user investment in innovation and user expectations of related benefit have been found to be correlated. Second, user dissatisfaction with existing products (services and processes) can serve as a proxy for expected benefit because it is logical that the degree of dissatisfaction with what exists will be correlated with the degree of expected benefit obtainable from improvements. Finally, speed of adoption of innovations may also serve as a surrogate for high expected benefit. Early adoption and innovativeness have been found often correlated with the adopter's perception of related benefit⁴⁷.

2. Identify lead user group

Once trend and benefit indicators are specified, one may screen the potential market based on the measures specified above via questionnaire and identify a lead user group. This is accomplished by a cluster analysis of the survey-based lead user indicators to find a subgroup which is the leading edge of the trend being studied and displays correlates of high expected benefit from solutions to related needs.

⁴⁷ Rogers & Shoemaker 1971

3. Generate concept (product) with lead users

The next step in the method involves deriving data from lead users related to their real-life experience with novel attributes and/or product concepts of commercial interest. This experience may include modifications to existing products or new products which they have created to meet their needs. Creative group sessions can be used to pool user solution content and develop a new product concept. In some cases the user solution may represent not only a concept but a fully implemented product.

4. Test lead user concept (product)

The needs of today's lead users are typically not precisely the same as the need of the users who will make up a major share of tomorrow's predicted market. Indeed, the literature on diffusion suggests that, in general, the early adopters of a novel product or practice differ in significant ways from the bulk of the users who follow them⁴⁸. One therefore next assesses how lead user data are evaluated by the more typical users in the target market. This can be done by employing traditional concept (product) test procedures after segmenting lead and non-lead user responses.

Another generic lead user process, presented by Lüthje & Herstatt, is illustrated in Figure 6. This process is close to yet another lead user process presented by Churchill et al⁴⁹. Even though there is a variety of these generic processes, one can easily note that they have a lot of similarities and the main elements are the same.

⁴⁸ Rogers 1962

⁴⁹ Churchill, von Hippel & Sonneck 2009

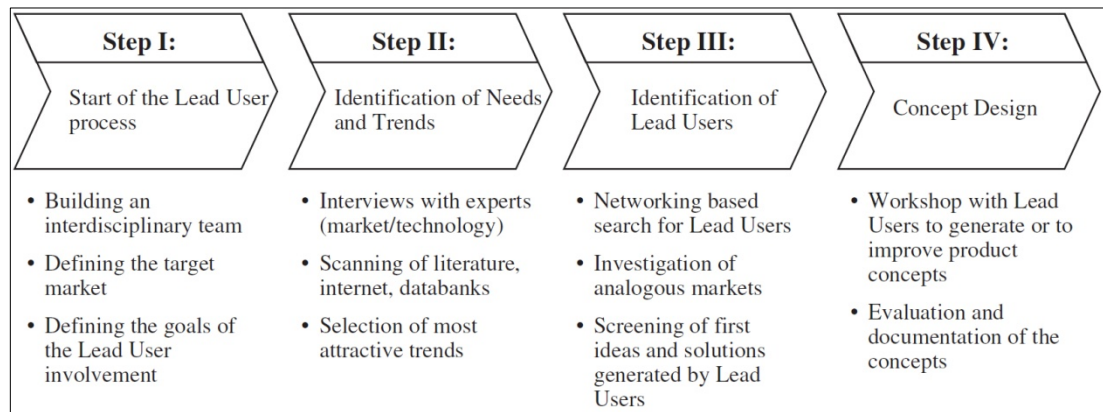


Figure 6 The generic lead user process presented by Lüthje & Herstatt⁵⁰

A company called 3M provides a real-life example of how the general lead user process described above can be successfully conducted in a company. 3M is a company known for its capability to innovate. In mid-90s, after concluding that too much of the company's growth was coming from changes to existing products, it was decided at 3M's Medical-Surgical Markets group that the lead user method should be tried in the creation of a breakthrough product. Their project, with generic lead user process forming a part of it, went through the following steps:⁵¹

1. A cross-disciplinary team was formed including people from marketing, R&D and manufacturing departments.
2. A goal to "*find a better type of disposable surgical draping*" was set.
3. The first month and a half was used to learning more about the cause and prevention of infections by researching the literature and interviewing experts in the field.
4. A workshop with the management and the project team was held with a purpose of discussing all they had learned and setting parameters for acceptable types of breakthrough products.
5. Next six weeks or so the team focused on getting a better understanding of important trends in infection control. A strong emphasis was put on understanding what doctors on developing countries need. The team realized that they did not

⁵⁰ Lüthje & Herstatt 2004

⁵¹ von Hippel, Thomke & Sonnak 1999

know enough of the needs of the doctors and hospitals in developing countries. The team broke in pairs and traveled to hospitals in several developing countries. Traveling led to important insights and to a redefined goal: *“find a much cheaper and much more effective way to prevent infections from starting or spreading that does not depend on antibiotics – or even surgical drapes”*.

6. The team networked their way into contact with innovators at the leading edge of the trend toward cheaper and more effective infection control. They found lead users in surprising places such as veterinary hospitals and Hollywood. In Hollywood they found makeup artists who are experts on applying non-irritating and easy-to-remove materials on skin.
7. Several lead users were invited to a two-and-a-half-a-day workshop. The participants reward for joining was purely intellectual. The central question of the workshop was: *“Can we find a revolutionary, low-cost approach to infection control?”* The participants met for several hours per meeting in changing small groups.
8. Six new concepts for product lines and a radically new way approach to infection control were generated in the workshop, and next the project team chose the best three concepts to be presented for the senior management.

The new radical approach to infection control resulted in changing the whole business strategy in the Medical-Surgical Markets group at 3M.⁵²

Previously presented implementation of the lead user method is not the only lead user project conducted at 3M. A performance assessment of the lead user method conducted by Lilien et al., which was mentioned also in the previous chapter, is based on seven lead user projects all completed at 3M⁵³. Research literature provides also various other examples of lead user cases that have taken place in other companies from which Herstatt & von Hippel and Urban & von Hippel for example have described the process in comparatively high detail^{54,55,56}.

⁵² von Hippel, Thomke & Sonnack 1999

⁵³ Lilien, Morrison, Searls, Sonnack, & von Hippel 2002

⁵⁴ Urban & von Hippel 1988

As said in the first chapter, this study concentrates on providing a foundation for implementing the lead method and benchmarking. It also considers the possibilities of the two approaches supporting each other. The following methods, *screening*, *pyramiding* and *broadcasting*, are the methods that would follow the groundwork resulting from the Participatory 3D modeling method developed in this study. The methods are explained since it is essential for fully understanding the purpose of the P3D method and for creating the integrated approach which combines the lead user method and benchmarking. P3D is presented in chapter 4 and the integrated approach is presented in chapter 6.

As mentioned earlier, one of the key things when implementing the lead user method is finding the lead users. There are few methods for identifying persons with desired attributes from a certain population. *Screening* is a more traditional method whereas *snowballing* and its variant, *pyramiding*, are becoming increasingly popular.

Screening approach is based on screening a lot of users in order to identify the sought attributes. This approach is suitable if the size of the population or amount of the customers in a market is manageable and it is possible to screen all subjects or customers. If the size of the population is too big, screening approach will be expensive and especially when finding rare lead user indicators, screening approach may be highly inefficient.

Snowball sampling is about asking individuals with rare and sought characteristics to identify individuals with those same characteristics⁵⁷. Pyramiding, a variant of *snowballing*, has an important difference. Pyramiding search is based on that individuals having a desired attribute tend to know other individuals who know *more* or have *more* of that attribute than themselves do^{58,59}.

Figure 7 illustrates the differences and steps of screening and pyramiding. Screening is a parallel search approach where every subject of a sample has to be analyzed for the sought attribute or attributes. The search area is bound by the limits of the sample. The

⁵⁵ Herstatt & von Hippel 1992

⁵⁶ Olson & Bakke 2001

⁵⁷ Goodman 1961

⁵⁸ von Hippel, Thomke & Sonnack 1999

⁵⁹ von Hippel, Franke & Prügl 2009

pyramiding search is a sequential approach which makes it possible to refine questions to be asked during the networking since the steps are repeated over and over until enough subjects with the sought attributes have been found. Another very important difference is the possibility to network the way to the previously described advanced analogous fields.⁶⁰

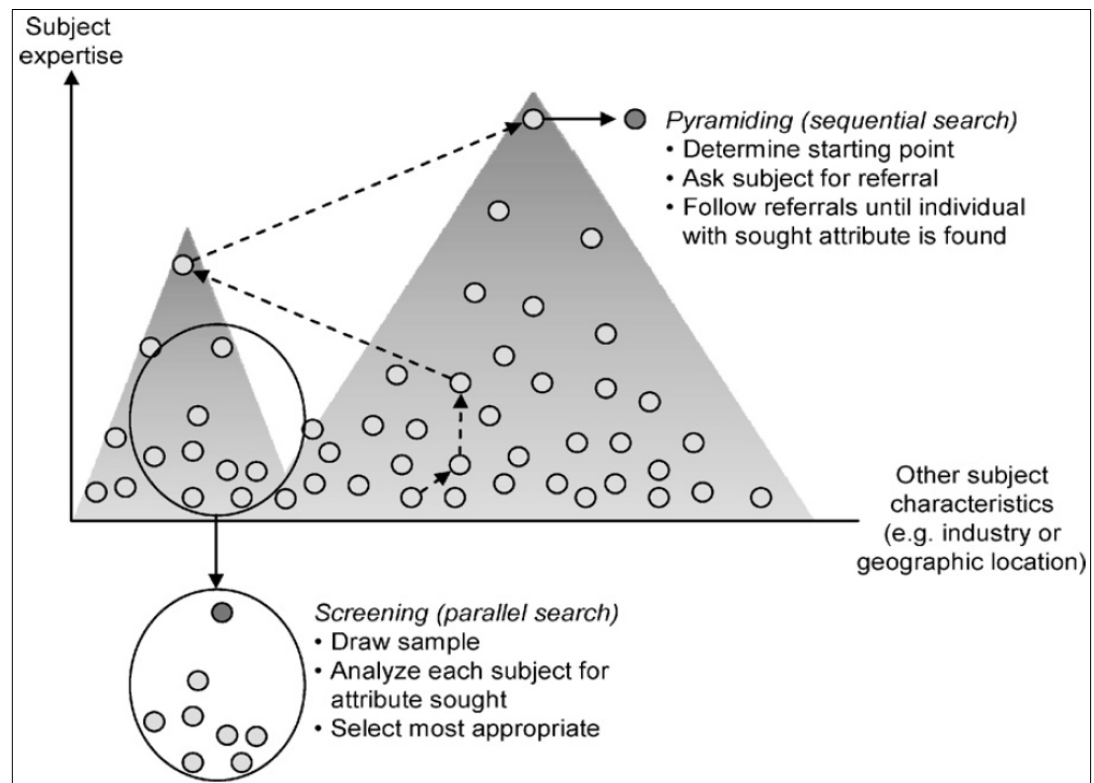


Figure 7 The search concepts of screening and pyramiding⁶¹

Von Hippel et al.⁶² have started the work of empirically testing the efficiency of pyramiding compared to screening in the search of lead users. In their study of 663 pyramiding search chains in 18 settings, to which mass screening approach was also applied, they found that *the effort of pyramiding search is on average only 28.4 % of the effort of screening*. However, already before proof of its efficiency in identifying lead

⁶⁰ von Hippel, Franke & Prügl 2009

⁶¹ von Hippel, Franke & Prügl 2009

⁶² von Hippel, Franke & Prügl 2009

users was existing, pyramiding has been successfully implemented in several other lead user cases^{63,64,65}.

There is no doubt of the efficiency of the mass screening approach in more suitable purposes. There are a lot of tools and methods for different purposes and when one would for example want to find out a percentage of users of a certain product, screening would be a proper tool as it goes through all persons in a population. However, lead user attributes are relatively rare⁶⁶. Screening would be unnecessary expensive and time consuming compared to the pyramiding method which has some clear advantages, like the possibility to venture into analogous fields and the possibility to further customize the method for a specific case while already implementing it.

Broadcast search, or *broadcasting*, is about transforming from a problem solver to a solution seeker and broadcasting the need for a solution. Some of the potential problem solvers who hear the message, self-select whether they will try to come up with a solution. In this way, the generation of solutions is shifted to external solvers.⁶⁷

Broadcasting method has been used in several lead user projects in identifying lead users, and often with another search method, such as pyramiding⁶⁸. According to Jeppesen & Frederiksen, there is a strong possibility that behind a good idea or solution, one can find a potential lead user⁶⁹.

Considering the lead user approach, broadcasting method shares an important characteristic with the pyramiding method. If the problem is broadcasted widely enough, it is possible to find lead users from analogous areas.

⁶³ Hienerth, Pötz & Hippel 2007

⁶⁴ Lilien, Morrison, Searls, Sonnack, & von Hippel 2002

⁶⁵ von Hippel, Thomke & Sonnack 1999

⁶⁶ von Hippel, Franke & Prügl 2009

⁶⁷ Lakhani 2006

⁶⁸ Hienerth, Pötz & Hippel 2007

⁶⁹ Jeppesen & Frederiksen 2006

3 Sources of Inspiration for Participatory 3D Modeling

The main goal of this study is to discover or develop a method for breaking a product or service into elements. These elements are to be used as a foundation for implementing the lead user method, which is supported by benchmarking, in the development of an existing product or service. A *Participatory 3D modeling method* (P3D) was developed to achieve this goal. This chapter presents the sources of inspiration that were used in the development of the P3D method. The method itself and the justification for it, are presented in chapter 4.

Chapter 3.4 presents the idea of *benchmarking* which helps in achieving the second goal of the study: considering the possibilities of the lead user method and benchmarking supporting each other through the method (P3D) presented in the study. Achieving the second goal is discussed in chapter 6.

3.1 Participatory Design

Participatory design originates from a Scandinavian approach that could also be called a work-oriented design approach. These names date back to 1970's when research projects on participation in systems development took place, and techniques were developed for workers to be able to influence the design and use of computer applications at their own workplace⁷⁰.

There are two approaches to participatory design: bringing the designers to the workplace, and bringing the workers to the designers' place⁷¹. Heiskanen et al. present these two approaches as the two main approaches for enforcing the interaction between the designer and the user⁷². Users can be involved in the design process by gathering their expectations, needs and ideas for example but since users are not always able to explain those needs or describe their use context, the designers should go to the users⁷³. Muller sees participatory design as a third space where users and designers are provided with a shared workspace for enforcing their interaction⁷⁴.

⁷⁰ Ehn 1993

⁷¹ Muller 2009

⁷² Heiskanen, Hyvönen, Repo & Saastamoinen 2007

⁷³ Heiskanen, Hyvönen, Repo & Saastamoinen 2007

⁷⁴ Muller 2009

Participatory design can happen in variety of forms. Muller et al. compiled a comprehensive taxonomy of participatory methods divided depending on who participates with whom. Examples of users participating in designers' worlds include *mock-ups*, *low-tech prototyping*, *theatre* and *co-development* while examples of designers participating in users' world include *collaborative prototyping*, *ethnographic methods* and *contextual inquiry*.⁷⁵

Buur & Matthews present participatory design as a part of a wider *participatory innovation* approach. Participatory innovation project is an activity where people's needs and practices are taken as a starting point in the creation of products and services. Opportunities are developed through an ongoing collaboration between users and company developers. The participatory innovation approach draws strength from participatory design, design anthropology and the lead user approach.⁷⁶

Participatory design is not one single method but a mindset and a growing pool of methods enabling participatory design. As Buur & Matthews see it, participatory design projects are usually not re-applications of one specific method but are instead engagements in methods development themselves⁷⁷.

3.2 Generative Tools and Design Games

When making the effort of organizing a possibility for participatory design to take place, it is self-evident that the most should be got out of it. Getting the users to designers or designers to users always requires resources. Designers, as facilitators of participatory design, have several methods and guidelines in use for example for preventing inhibitions, fueling creativity, getting participants and documenting. The gamut of all possibilities is vast and this chapter introduces the general idea with the help of a few examples. These examples do not represent all types of methods in the field of participatory design but the types that act as sources of inspiration for Participatory 3D modeling method developed in this study.

UTOPIA was a project with a goal to design the future of computer-supported newspaper production, and it provides an example of using *mock-ups* and *design games*

⁷⁵ Muller, Wildman & White 1993

⁷⁶ Buur & Matthews 2008

⁷⁷ Buur & Matthews 2008

as ways to implement participatory design in redesigning the working process of typographers and journalists. A whole setup was built, including paper sheets on the walls, slide projectors, screens, chairs, cardboard box and such. The relationship between typographers and journalists was tense and new practices were needed. When having those typographers and journalists participating in the game, the project team was able to see how they cooperate and to suggest a solution for them in a form of a cardboard box. The cardboard box was a mock-up of a strategically situated laser printer that would radically change the process. A common device in the world of today was a device from the future when the mock-up was built – back in the year 1982.⁷⁸

Users do not always possess the means to fully expressing themselves. One answer to this problem is *cultural probes* which allow people to express themselves by taking pictures during their everyday life with a disposable camera, for example⁷⁹.

Another answer is *generative tools* which also provide users with a visual language, in contrast to the more traditional verbal methods. Generative tools are created by putting a number of components together into toolkits from where people select the components in order to create artifacts that express their thoughts, feelings and/or ideas. For example, a dream might be difficult to express in words but can be imagined as pictures in a person's head.⁸⁰

In general, games have an entertaining, social or educational aim. A game usually has an objective that is to be achieved abiding a certain set of rules. It might have an element of competition or might be influenced by chance.

In participatory design games, players seldom compete in order to win but have different interests and preferences, and the aim is to take advantage of various skills and areas of expertise, and jointly explore design possibilities within a game setting. Brandt has a diverse compilation of different types of exploratory design games, a *silent game* aiding in concept design being one of them. In the design game there are two players who are not allowed to speak to each other. The first player invents a pattern and the next player tries to understand the pattern and expand it by following the principles of the first

⁷⁸ Ehn & Kyng 1991

⁷⁹ Gaver, Dunne & Pacenti 1999

⁸⁰ Sanders 2000

player, and eventually to find a personal pattern for the first player to follow. Game pieces can be anything from pieces of wood to buttons in various sizes and shapes. There should be a lot of game pieces and they should not refer to any real-life artifact.⁸¹

Different types of generative tools provide the user with the means to communicate and games act as setting for the generative tools. Stappers & Sanders conducted a series of small experiments with generative methods and concluded that non-designers can express themselves creatively using various generative tools and that there were no winners or losers among the conditions – only unique and useful insights into people's lives and expectations for their future⁸². Exploratory design games are fun and engaging events with an informal, and thus the most creative, atmosphere⁸³.

Games have also an important role as warm-ups. Creative mindset requires a positive and relaxed feeling and a common way to achieve this is by telling jokes and playing games⁸⁴. These warm-up games may have characteristics of, but are not restricted to, design games.

3.3 Affinity Diagram

Affinity diagram is a method for gathering qualitative data and organizing the data into subgroups based on similarities^{85,86}. In addition to similarities, data can also be clustered according to any intuitive relationships such as dependence, proximity, issues or problems^{87,88}. The method can be implemented for example by using post-it notes or cards where one can write any single idea, element, question or whatever is being categorized. This makes moving of the elements easier between the groups. The groups can be named describing the content of the group. The method is further explained by a simple example in Figure 8. The method is also known as a KJ method after its developer, a Japanese anthropologist, Kawakita Jiro⁸⁹.

⁸¹ Brandt 2006

⁸² Stappers & Sanders 2003

⁸³ Brandt 2006

⁸⁴ Norman 2004

⁸⁵ Cohen 1995

⁸⁶ Otto & Wood 2001

⁸⁷ IDEO 2003

⁸⁸ Beyer & Holtzblatt 1999

⁸⁹ Mind Tools Ltd. 2010

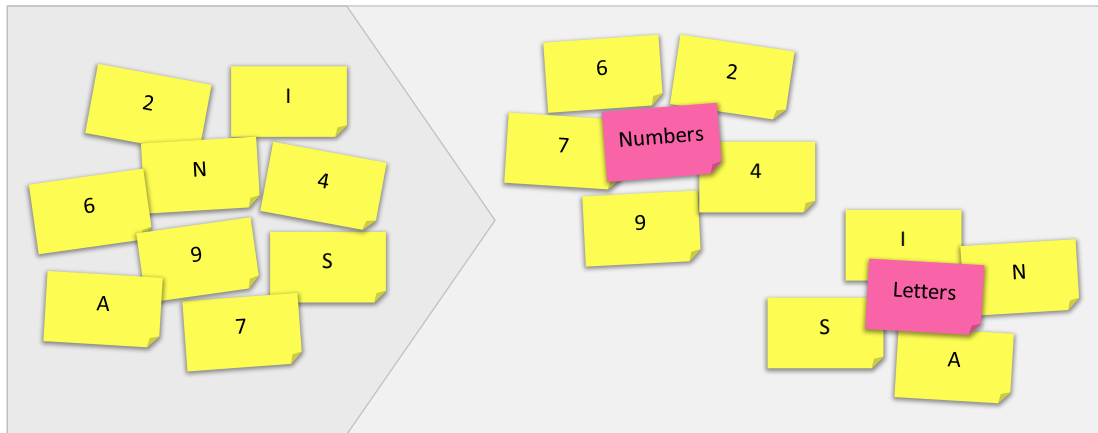


Figure 8 Grouping data based on similarities using affinity diagram

3.4 Benchmarking

The field of *benchmarking* research and literature is vast. Benchmarking has evolved over time while different types of definitions for benchmarking have multiplied.

Watson offers a definition for benchmarking: *A systematic and continuous measurement process; a process of continuously comparing and measuring an organization's business processes against business leaders anywhere in the world, to gain information that will help the organization take action to improve its performance*⁹⁰. Bhutta & Huq present another one: *Benchmarking is first and foremost a tool for improvement, achieved through comparison with other organizations recognized as the best within the area*⁹¹. Camp gives yet another definition: *Benchmarking is the search for industry best practices that lead to superior performance*⁹². The definitions mentioned above are just examples among many. When examining the definitions in a larger scale, few characteristics emerge: measurement via comparison, continuous improvement and systematic procedure in carrying out the benchmarking activity⁹³.

Benchmarking is often traced back to late 1970's when Xerox^{94,95} started formalizing the benchmarking process.

⁹⁰ Watson 1993

⁹¹ Bhutta & Huq 1999

⁹² Camp 1989

⁹³ Ahmed & Rafiq 1998

⁹⁴ Camp 1989

⁹⁵ Watson 1993

Benchmarking was however conducted already after World War II by Japanese when American products such as chewing gum, Coca-Cola and Jeep started flowing to Japan. When more and more Japanese visited the United States, they saw the intimate relationship of supermarkets and the daily life in America. Japanese curiosity and fondness for imitation led to the birth of the first U.S.-style supermarket in Japan in the mid 1950's. Taiichi Ohno, former vice president of manufacturing for Toyota, applied his observations of supermarkets in the development of just-in-time (JIT) inventory management method, using the shelf restocking of supermarkets as an analogy.⁹⁶

Camp⁹⁷ classifies four different types of benchmarking based on the type of partner, as follows:

Internal benchmarking

Most multidivision or international firms have similar functions between different operating units. Comparing these internal operations is one of the easiest benchmarking investigations as there are no problems of confidentiality and data is often readily available. This data might be as complete and extensive as desired.

Competitive benchmarking

The most obvious benchmarking partners are direct product competitors. Obtaining information from direct competitors might be difficult but still something worth to pursue. Obtaining information is possible since other parties are also interested on understanding which of their operations are successful or require improving.

Functional benchmarking

Dissimilar industries often have similar functionalities and a great potential lies in identifying and benchmarking functional competitors or industry leader firms. However, one should make sure that those industry leaders are driven by the same customer requirements, such as high customer satisfaction for example, in order to guarantee the comparability of operations. Functional benchmarking is often productive also since sharing data and confidentiality are not problems.

⁹⁶ Ohno 1988

⁹⁷ Camp 1989

Generic benchmarking

Regardless of the dissimilarities of industries, some functions or processes are the same. A single product or industry does not limit the benchmarking and the investigator may uncover practices and methods that have not been implemented in the investigator's own industry. Easily transferable and proven technology can be found. Generic benchmarking requires objectivity, broad conceptualization and an understanding of the generic process.

There are additions⁹⁸ to the types of benchmarking described above such as *competence benchmarking*, *global benchmarking* and *network benchmarking*, and an addition to classifications of benchmarking based on generations⁹⁹ – among many other classifications based on types, processes, approaches and the like.

Among all definitions, classifications and processes, some crucial similarities can be identified. Determining what to benchmark, and with whom, are something to be done in all benchmarking projects. The first steps are close to being the same in all benchmarking processes. Watson¹⁰⁰ reduces the first step to answering two questions: *What should we benchmark* and *whom should we benchmark?* Similar first steps are in one of the most famous benchmarking process – the ten-step process of Xerox, illustrated in Figure 9.

The similarities between the first steps of benchmarking and the first steps of the lead user method are distinctive. As explained in chapter 2.3, the beginning of the generic lead user process includes steps called *find market or technological trend and related measures* and *identify lead user group*¹⁰¹. These two approaches, lead user method and benchmarking, share also one of the basic ideologies behind both of them – finding solutions outside the house, or even outside the whole industry (*analogous fields*). Also in benchmarking can partners, practices and such be identified independent of the industry^{102,103}. If the approaches have this much in common, one could ask if similar

⁹⁸ Kyrö 2003

⁹⁹ Watson 1993

¹⁰⁰ Watson 1993

¹⁰¹ Urban & von Hippel 1988

¹⁰² Camp 1989

¹⁰³ Watson 1993

methods could be used when conducting the first steps of both approaches. This matter will be further discussed in chapter 6.

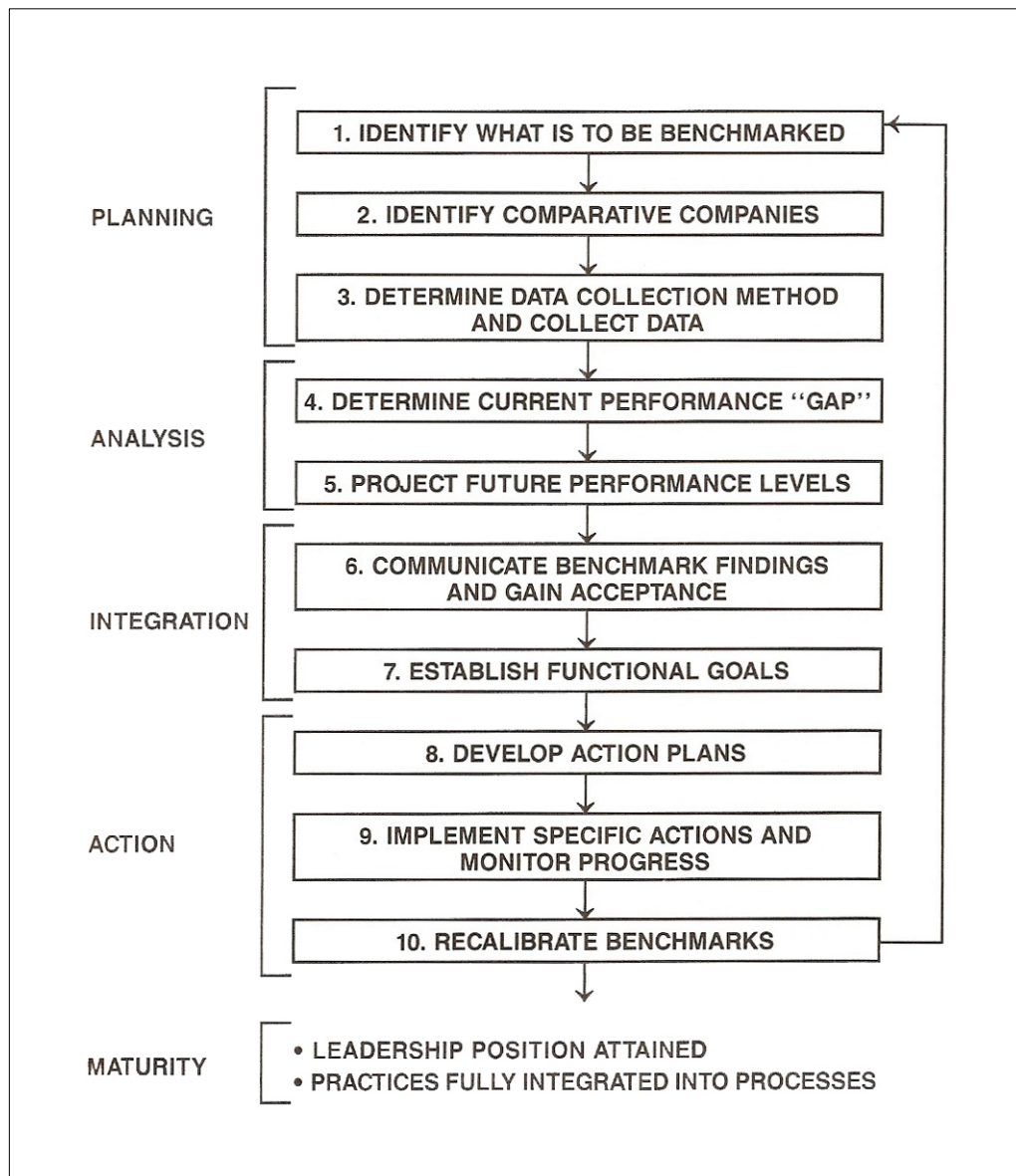


Figure 9 Benchmarking process¹⁰⁴

3.5 Reverse Engineering

It is not uncommon for even a young child to ponder how something works and to try figure it out by opening it and taking it to pieces. This type of thinking represents the basic idea of *reverse engineering*.

¹⁰⁴ Camp 1989

Otto & Wood presents reverse engineering as a part of a reverse engineering and redesign methodology – a process that starts with a product in market and a vision to redesign it. The process consists of three overlapping phases in the following order: *reverse engineering, modeling & analysis* and *redesign*. The approach makes it possible to create the essential material for understanding the product. For example, a design team would probably not tear down a product of their own to understand it but a student, for whom the product is new, has to take the past design into pieces in order to fully capture the idea of how the product works.¹⁰⁵

As Otto & Wood put it, the intent of the reverse engineering phase is to *fully understand and represent the current instantiation of a product*¹⁰⁶.

The reverse engineering phase alone consists again of several phases, including selecting a product, developing a vision, analyzing customer needs and analyzing market opportunities. Otto & Wood provide methods for the reverse engineering phase. The relevant method considering this study is a process called *tear down*, which culminates in the disassembly of a product. The tear down process consists, again, of several phases which can be carried out in several different ways. The main idea, a characteristic shared by all of those ways, is the systematic and organized manner of implementing the tear down process.¹⁰⁷

Reverse engineering and tear down are also brought up by Watson who places them as parts of the first generation of benchmarking¹⁰⁸. Otto & Wood mention the possibility to perform tear down to several products in the market in order to clarify shared systems among products¹⁰⁹. Otto & Wood¹¹⁰ also show how benchmarking is a part of a reverse engineering process, when for example generating metrics for previously assigned target values for a specific product. The target values are a result of benchmarking related products or technologies and of an examination of relevant customer needs.

¹⁰⁵ Otto & Wood 2001

¹⁰⁶ Otto & Wood 1998

¹⁰⁷ Otto & Wood 2001

¹⁰⁸ Watson 1993

¹⁰⁹ Otto & Wood 2001

¹¹⁰ Otto & Wood 1998

4 Methodology Used in the Empirical Study

This chapter describes the methodology used in gathering the empirical evidence for this study. As said, the main goal of this study is to discover or develop a method for breaking a product or service into elements. These elements are to be used as a foundation for implementing the lead user method, which is supported by benchmarking, in the development of an existing product or service. The following two chapters describe two very different approaches, both aiming to achieve the same goal. The approaches were implemented in breaking a media based teaching and learning service, Opettaja.tv, into elements.

The view of an *external investigator* is the view of my own. The subjective nature of this approach, and its inability to confirm the extensiveness of its results, led to the need for the *Participatory 3D modeling method*. The P3D method draws its inspiration from the sources introduced in the chapter 3.

4.1 View of an External Investigator

The view of the external investigator was acquired by multiple methods and information stumbled upon by chance, such as random discussions without any particular goal. Coming across valuable information without any systematic method was no reason to exclude it from the study.

The process was started by getting familiar with Opettaja.tv by surfing around the service, getting a picture of the users inside the surface, and using search engines in finding connections between Opettaja.tv and for example other services. Also, a user profile to the service was made for getting access to all features.

After acquiring preliminary picture of the Opettaja.tv and its surroundings it was possible to have open discussions of Opettaja.tv with the people behind the service. Discussions were held with the Project Manager, Development Director and Executive Producer at YLE.

The discussions at YLE resulted also in providing the investigator with feedback of Opettaja.tv, acquired earlier by YLE. Innope project team members of YLE also shared a

thesis¹¹¹ studying Opettaja.tv, which proved to be a helpful addition in the effort of finding out all about Opettaja.tv.

Next, the service was examined in a structured manner. The online site of Opettaja.tv was browsed through systematically, listing all features, stakeholders, notions and such. The list was filled further with insights from the notes of the previous discussions, feedback, findings of the thesis¹¹² and matters stored by *cognitive mapping* and note taking carried out during the previous phases.

During the whole process, a lot of discussion happened between colleagues within the project team and with teachers, or persons studying to be teachers, from the social circle of the external investigator. This information is valuable and even though it was not gathered with a structured manner, it would be unreasonable to disregard it.

All the elements of Opettaja.tv found out by the external investigator were grouped into entities according to similarities. The entities were also given names describing the entities. The grouping and the naming of the entities were based on the analysis of the external investigator with an aim to cover all possibilities. For example, some same elements can be listed under several different entities.

From this point on, the external investigator will be referred as *investigator*.

4.2 Participatory 3D Modeling

The Participatory 3D modeling method takes a form of a workshop. The following chapter, 4.2.1, introduces the two situations where the P3D method was used. The chapter after the next one, 4.2.2, describes the flow of a P3D workshop in a detailed manner.

4.2.1 Case Descriptions

Two Participatory 3D modeling workshops were organized with an identical goal of finding out how users and designers perceive Opettaja.tv, from what elements does Opettaja.tv comprise of, and how can those elements be divided into labeled entities.

¹¹¹ Karppinen 2009

¹¹² Karppinen 2009

The participants of the first workshop were all young teachers finishing their studies and all of them were familiar with Opettaja.tv. This workshop is referred to as a *user workshop*. The user workshop took place in the Aalto Design Factory. The room used had a customizable set of video cameras and microphones on the ceiling for full audio and video recording of the workshop, ensuring that nothing would be missed by the project team. The workshop and the results of the workshop were also photographed. The only requirement for the persons participating in the user workshop was that they should be familiar with Opettaja.tv.

The participants in the second workshop were all members of the Opettaja.tv development team at YLE. The workshop, called the *designer workshop*, had five participants. This workshop took place in a meeting room in the premises of YLE. The workshop was documented by using audio recorder and by taking notes and photographs.

All the phases of the P3D modeling workshop are thoroughly described in the following chapter. Both workshops had the same steps and the intention was to have two workshops as similar as possible but with participants with different backgrounds; users and designers. There was, however, a small difference in one phase. As the P3D method itself was and is under development, the users in the workshop were not asked to give names to the entities formed in the *grouping phase* while the participants of the designer workshop, which was organized later, were asked to label the groups.

4.2.2 Workshop Flow

A complete P3D workshop consists of five main phases each of them including several steps. Those phases are: *preparation*, *warm-up*, *model building*, *disassembling* and *grouping*.

Preparation

In P3D method the participants' knowledge of the product or service in focus plays an important role and thus the selected participants need to be as familiar with the product or service as possible. A suitable amount of participants for one session is from three to five while two facilitators are needed to successfully run the P3D workshop.

Also construction materials have a fundamental role. A specific set of accessories, listed in Table 1 and illustrated in both Figure 10 and Appendix 1, is provided for the participants use later in the model building phase. The accessories are chosen based on familiarity, modeling characteristics, availability and price. Also, a projector, a table with a plain surface, chairs, a stack of white plain paper sheets and a white board or a wall where one can attach post-it notes are needed. The workshop takes place in a space with no distractions and from two to three hours of time should be reserved for completing it.

Table 1 List of the accessories used in the P3D workshop

Accessory	Measurements	Quantity
Wooden pawn	h=47/60 mm, d=22/29	2 x 4
straw (different colors)	h=210 mm, d=5 mm	60
wooden stick	h=300 mm, d=6 mm	10
wooden straw	h=300 mm, d=3 mm	20-30
paper string	approx. 10 m	-
sticker sheets (numbers, letters, stars)	approx. h=10-40 mm	1≤sheet with 20≤stickers of each
pipe cleaners (different colors)	h=300 mm	45
scissors	-	3
marker (black)	sharp pointed	one per participant
modeling clay (different colors)	-	approx. 500 gr
post-it notes (two different colors)	-	10 stacks
transparent adhesive tape	-	one roll
hollow cardboard cone	h=130 mm, d=70 mm	7

From the very beginning, it is important to make the participants feel comfortable and motivated, by giving a proper welcome at arrival for example. When the workshop is ready to begin the participants are asked to sit on the chairs around the table. At this point they may be shown some limited background of the study going on, but results of possible previous similar workshops or results acquired with other methods should not be shared. Providing only limited information is to prevent it from influencing the outcome of the workshop.



Figure 10 Accessories provided for the participants of the P3D workshops

Warm-up

Before the actual P3D method takes place, a warm-up activity is held with a purpose of ensuring every participant gets into proper mindset and mentally ready for the next phases. It also acts as a team building exercise.

Every participant is given A4 size plain paper and a pen. A stack of paper is put on the table for the participants to restock from, and pens found in the accessory set can be used already in this phase. The participants are then asked to once fold the paper both horizontally and vertically in turns, opening it in between and after, resulting in the paper having four rectangular sections divided by the folds. Next, they are asked to put the paper *horizontally* in front of them on the table. When ready, they are instructed to individually generate as much ideas as possible in three minutes and to put those ideas on the paper any way they see fit, by drawing or writing for example. Each idea is put on a separate section on the paper and they can use as much paper as they can. The participants are told that in the next step of the warm-up, they will together further develop those ideas and that this is a reverse brainstorming approach. At this point they are ready to be told the subject, which is to generate ideas for the

worst possible bicycle ever – for the whole bicycle or a separate part. It can for example be extremely unusable or ugly. While explaining the subject the participants are simultaneously shown pictures of existing bicycles and concepts, for example traditional, non-traditional or even peculiar looking bicycles, race bikes, old bikes, unicycle, et cetera. The picture cavalcade is then put away and the participants are asked to start. In order to keep the pace up during the warm-up, the participants are informed of the time passing minute by minute and at 30 and 10 seconds and, finally after three minutes, to stop. Some of the action of the warm-up phase is illustrated in Figure 11.



Figure 11 Warm-up phase in progress

When the first warm-up step is completed it is time for the participants to continue developing the worst bicycle further by discussing together, throwing in more ideas and building on top of the ideas generated during the previous step. If they choose to, they can have one of them writing everything down instead of everyone writing. They are again given three minutes of time.

The next step is the final step of the warm-up. The participants are asked, based on everything accomplished during the previous step, to generate two bicycle concepts – the worst and the best bicycle ever. The development of the latter one should be based

on the findings learned when generating ideas for the worst bicycle. The participants are now given two plain papers, one for each concept, and five minutes of time. After five minutes the participants are asked to briefly present their collaboratively created concepts.

After presenting the concepts the facilitators can summarize the purpose of this warm-up in achieving an open and creative mindset, and in building a team. It should also be emphasized how reverse thinking, brainstorming for the worst bicycle, led to finding fundamental parts and features of a good and functional bicycle.

Model Building

In the beginning of the actual P3D method the accessory set described earlier is put on the table and possible containers are opened for the participants. This is to make sure none of the accessories is left unused because participants did not dare to use them. The objective is to minimize all possible inhibitions. For example, the modeling clay is removed from its container. All accessories are divided evenly on the table in a way that allows all the participants to reach everything.

While the other facilitator is setting up the accessories, the other one explains and shows instructions using the projector. The participants are asked to build the product or service on the table in 3D format using the materials in the accessory set. Great emphasis is put on telling that all solutions are correct solutions and that we are not after a high detailed masterpiece, as well as on the fact that they are meant to build the present service as they see it – the one that already exists and they are familiar with. Term “develop” or terms similar to it are not to be used at any stage before the workshop activities have been completed as this might drive the participants towards generating ideas for improving the existing product or service, instead of just modeling it. Also, all materials can be used freely, although everything does not have to be used. The dimensions of the table and the possible ceiling are the only physical limits. The participants are encouraged to “get their hands dirty”. Next, several pictures of similar workshops, activities, rough prototypes, messy paintings or anything related are shown aiming to get everyone even deeper into suitable, uninhibited, mindset. The idea of showing pictures is similar to having mood boards

in a design project for example. While participants are watching the pictures, they are reminded of the previously mentioned instructions.

After participants' possible questions have been answered it is time for the participants to start building the product or service (see Figure 12 and Figure 13) and for the facilitators to become mainly spectators. The facilitators continue answering possible questions and help over possible blockades by asking guiding questions. When the participants have grasped the idea of the method and are starting to wonder how to build the product or service, they are advised to think of an element they want to build out of the given materials, instead of thinking what they could build out of the available materials. This approach decreases the chance of available materials restricting the variety of product or service elements participants might want to build.



Figure 12 Starting the model building

From 60 to 90 minutes is given for the participants to build the product or service, depending on the nature and complexity of the product or service in focus. The exact amount of time available is not given but the participants have some sort conception of it based on the schedule of the whole event. An estimation of the time left might be told during the phase in case it seems that the participants will not finish in time. When the participants think they are ready or the time planned has almost elapsed, the

participants are asked if they are certain that every element of the product or service has been modeled.



Figure 13 Model building in process

When the participants confirm that they have finished, the facilitators clean up the table from everything except the model that has just been built. When the model is alone on the table, the participants are asked to briefly present the main elements of their accomplishment.

Disassembling

In this phase, the participants disassemble the previously built 3D model in a structured manner. First, the participants are asked to briefly present the main elements of their model. Next, they are instructed to, one by one, pick up elements so small they can be described with one or two words, as illustrated in Figure 14. Facilitators write every description on separate post-it note and attach them on the board or wall either randomly or side by side without grouping them in any way. This continues as long as every element is labeled and there is nothing left in the

previously built model. All the post-it notes should be of the same color. This is to prevent different colors influencing the following phase, grouping.

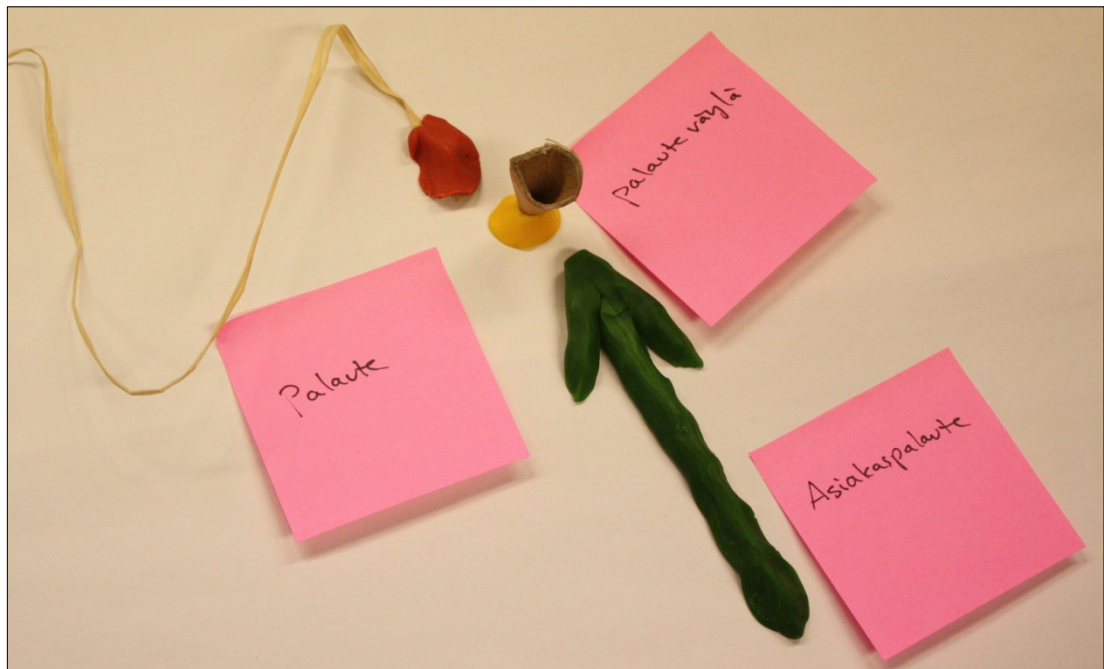


Figure 14 Disassembling phase in progress

Grouping

When all elements are written on separate post-it notes, the participants are asked to stand up and come next to the board or wall where the post-it notes have been attached on. Having them stand up both refreshes them after sitting through the previous phases and gets everyone participating more likely in the following activity. The next step is forming groups out of the elements. The participants are asked to think if some of the elements have something in common and if they can somehow group them into entities. They are also asked to label every entity and to either write the names on a board, wall or on a separate post-it note attached next to the group (see Figure 15). If post-it notes are used for labeling the entities, they should be of different color than the element post-it notes. Resulting entities are the main outcome of the method. Those entities represent the main components from which the whole product or service consists – as perceived by one particular group of participants.

After the official workshop the participants are asked for freeform feedback and feelings of the P3D workshop.

5 Results and Analysis

5.1 External Investigator

The research conducted by the investigator comprised various methods including open discussions, systematic familiarizing with the service, reading a study of the service, feedback gathered by YLE, random encounters with people affiliated with the service and grouping the gathered elements according to similarities. The combined outcome of the investigation is presented in Table 2.

The resulted list of elements is extensive and probably covers most of Opettaja.tv. However, one cannot be certain of its extensiveness. Also, the aim to cover the possible ways of grouping the elements of Opettaja.tv soon pointed out its impracticality. The elements could be grouped in numerous other ways, according to inputs/outputs or student/teacher for example. Even though various sources of information were used, the final result and especially the formed entities are a subjective product of one mind. This was fortunately noted on early stage and a method aiming to achieve a more objective view, the Participatory 3D modeling, was developed.

The view of the investigator has several levels of elements under the main entities. For example, *goals* are divided into goals for *teachers*, *pupils* and *YLE* and this entity also includes the slogan of Opettaja.tv: *To lighten the everyday life*. This view of Opettaja.tv includes six entities and 78 elements when calculating only the lowest level elements each category has. A subcategory including lower elements is not included in the count but all those lower elements are. The Opettaja.tv slogan for example is taken into count but teacher, pupil and YLE are not.

Table 2 View of the external investigator

Functions and features live programs (YLE Teema) programs streamed (internet) staffroom discussions moderated teacher of the month teaching tool saved class plans shared class plans education courses for further educating online series external webtools director adapting for own use discussions in forums essays report and assignment forms assignments ready-made materials ready-made theme packets articles account control registering password personal information navigating searching favorites	Methods/Tools recording a program DVD VHS digital converter box ordering showing the program streaming from the web DVD player VHS player TV broadcast discussion forum saving class plans to personal favorites sharing class plans sharing class plans for everyone sending a link of a class plan to a friend advertising notices/newsletters events social media (FB,...) Opettaja magazine	Concepts learning teaching controlling ones content presenting producing navigating discussion/communication rewarding marketing searching personalizing how-tos ("tutorials") moderating account control sharing content
Essential services programs staffroom teaching tool education ready-made materials	Goals YLE service more widely known service more used offer teachers tools for their profession teacher to teach to change thoughts to get support from peers to educate further to make plans for classes to create content for the class to search teaching material to produce teaching material pupil learn learn also social skills "To lighten the everyday life"	Channels web service TV programs events tour fairs etc. Studio Kotro

5.2 Participatory 3D Modeling

5.2.1 Users

The participants of the user workshop used all different types of materials available in building the 3D model of the Opettaja.tv. The amount of all materials was sufficient. The table did not seem to limit the modeling since there was a lot of space still unused. The final 3D model built by users can be seen in Figure 16. The model shows some symmetry and has a noticeable structure. The systematic nature comes from the small wooden pawns in the centre surrounded by the bigger wooden pawns and cardboard

cones. Interestingly, the users also used the table as building material by assigning the table to act as YLE.

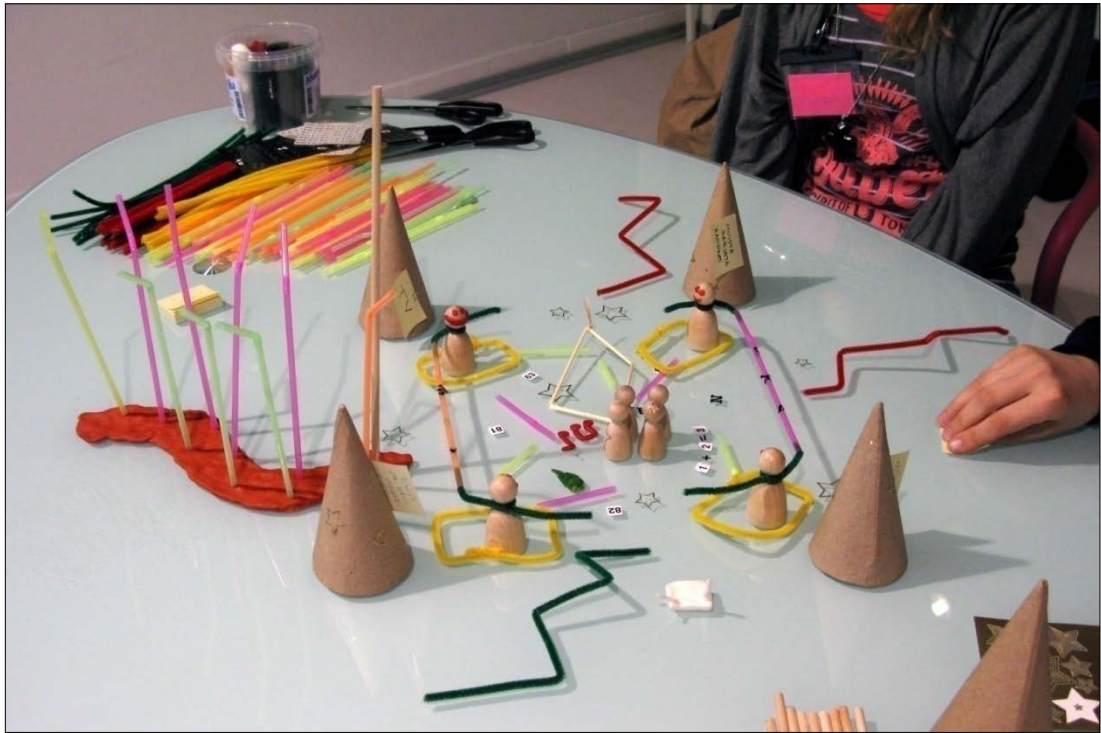


Figure 16 The final 3D model of the user workshop

The users' model comprised 16 elements divided into 5 entities, as illustrated in Figure 17. They modeled some clear features of the service such as *teaching tools* and *programs* but the general level of the model was abstract with the majority of the entities, such as *learning experiences and results*, *communication (discussion among teachers)* and *information flow*, not being as tangible.



Figure 17 Elements of the users' model

5.2.2 Designers

The participants of the designer workshop utilized all different types of material available except for the four bigger wooden pawns. The final 3D model built by the designers, illustrated in Figure 18, seems to show more complexity compared to the one the users built. Also the amount of material used is clearly higher although the space available was smaller since the white paper protecting the table clearly acted as a boundary.

The 3D model of Opettaja.tv built by designers consisted of 51 elements that formed 8 entities, all illustrated in Figure 19. Although designers had some abstract elements, they clearly concentrated on modeling the service in a more concrete way by having a lot of service features and technical solutions such as *user interface (filtered)*, *feedback* and *online teaching material*.

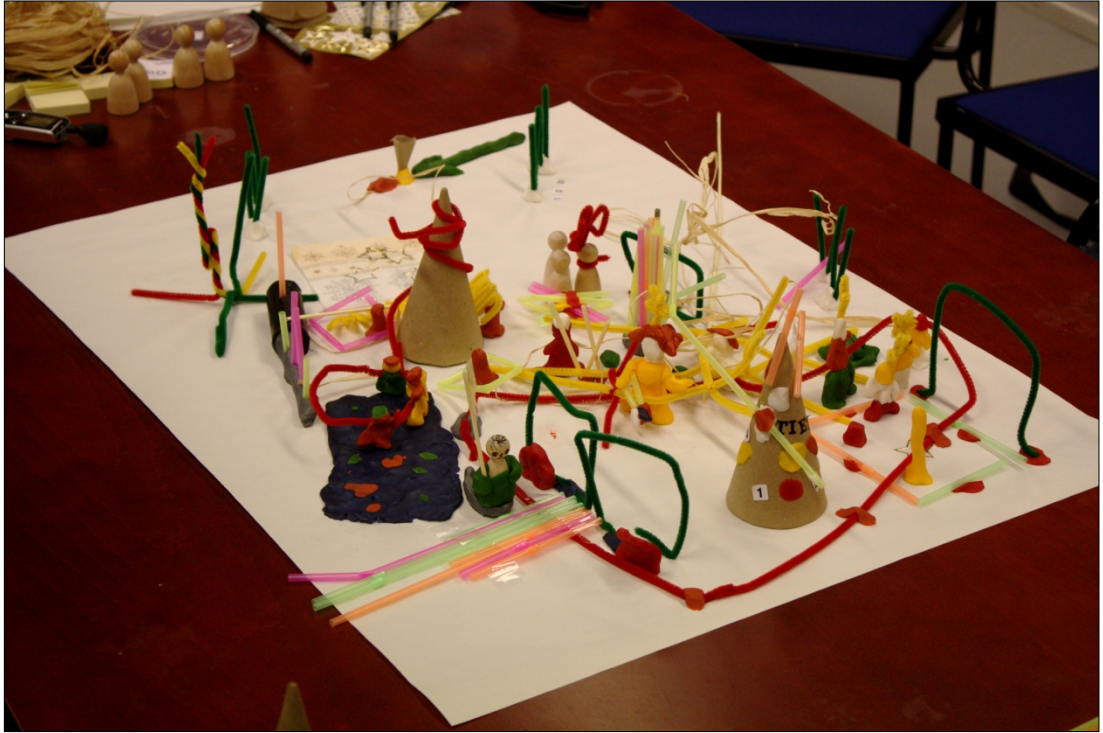


Figure 18 The final 3D model of the designer workshop



Figure 19 Elements and entities of the designers' model

5.2.3 Users versus Designers

The warm-up held in the beginning of both user and designer workshops proved its usefulness in getting the participants into the correct mindset. There was no hesitation for grasping some material and making it a piece of the common goal, a 3D model of Opettaja.tv, in either workshop. In the case of the user workshop, participants did not know each other beforehand but they seemed to bypass possible inhibitions and everyone had the courage to participate and work together towards the common goal. In the designer workshop all participants knew each other quite well. In this case, however the average age of the participants was higher so the role of the warm-up might have been a little different by lowering the possible threshold of the participants to play with the arts and crafts material. The participants of the designer workshop seemed to be daring, conversational and active persons which helped in achieving the goal of the warm-up phase – removing possible inhibitions and getting into creative mode. The warm-up caused a positive change in the atmosphere and the benefits of such phase are indisputable.

The difference of the backgrounds of the both participating groups was evident. The designers' model concentrated on technical solutions and features of Opettaja.tv while users' model did not include that many individual elements of the service. The users viewed the service by asking what it enables them to do instead of how it is done. A good example of this is how designers had an element in their model describing *discussion in the web (for registered users)* in contrast to users' model having an element *communication (discussion among teachers)*.

Another example bringing forth the difference between the view of the users and the designers was how the users (teachers) automatically used small wooden pawns for pupils and bigger wooden pawns for teachers and put the pupils in the centre of the model and further highlighted the message by saying that "*pupils are in the center of Opettaja.tv*". Interestingly, the participants of the designer workshop immediately excluded the pupils from the model in the beginning of their 3D modeling phase. After noticing the wooden pawns in the available material, the designers decided on having the small wooden pawns represent teachers and bigger wooden pawns represent pupils since "*pupils have bigger and brighter brains*". However, designers soon concluded that

pupils should be excluded altogether, saying “*Pupils have no role in Opettaja.tv. They are not part of it*”. Note the position of small wooden pawns in the centre of the users’ model in Figure 16 and in the top left corner outside the designers’ model in Figure 18. In reality, pupils are linked to teachers who in turn are linked to Opettaja.tv – only the direct link is missing. The pupils actually have the possibility to use Opettaja.tv since anyone can register and it even has one feature allowing the students to input answers to questions without registering. Nevertheless, the service is still clearly targeted to teachers.

The users clearly modeled elements that are not part of the service concept of Opettaja.tv but that are part of their overall experience relating to the service concept. Many of their elements represent the use process and other processes related to the use context. Users modeled elements such as *interaction between teachers and pupils* that are not a clear part of the service but are part of the teachers’ everyday life. The user’s perception seems to be much wider compared to the mere use context of the service.

The participants of the designer workshop, who are also entangled into what happens behind the service, used this insight in their modeling. The designers had elements such as *feedback from Finnish National Board of Education, Ministry of Education and Finnish National Board of Education* and *international joint projects (+partners)*. The participants of the user workshop also realized that there is something behind Opettaja.tv and even if they knew any details about it, they still referred to these elements just as *YLE and other partners (service providers and designers)*. The addition in parentheses guides the element in to more practical direction, away from ministry level actors. The designers had knowledge of the external players. However, as the designer is the one responsible of the designing and this information has an impact to designing but not as much to using, user might not see it and might not even be interested in it – it is irrelevant for the users who see the modeling as a way to show *what* the service enables instead of *how* it enables it.

5.3 P3D versus External Investigator

The view of the investigator had 78 elements in 6 entities in contrast to users’ P3D result of 16 elements in 5 entities and designers’ result of 51 elements in 8 entities. These

numbers, although can give some direction to the comprehensiveness of the view, do not tell the full story. Emphasis should be given to the nature of those elements and results.

The view of the investigator is very detailed compared to the views built in P3D workshops. For example *recording a program* has been specified further to include *DVD, VHS, digital converter box* and *ordering* while the other two views do not have recording but only the idea of the programs available, in form of elements such as *TV (and its programs)* (users) or *TV programs with varying lengths and structures* (designers) or *TV program for teachers* (designers).

The detailed nature of the investigator's view does not compensate the diversity of the two other views. For example, the users really highlighted the importance of pupils by saying that "*pupils are in the center of Opettaja.tv*" while the investigator only included pupil as someone who has a goal to learn. A person new to the results of the study would not get the level of importance the users gave to pupils by inspecting solely the tangible results P3D. It has to be separately pointed out by explaining the symmetry in the final 3D model, the position of pupils in it, and by quoting the participants.

The P3D modeling method showed its strength in bringing the background of the participants into the models. It is clear that the investigator is not either user or designer of Opettaja.tv – or at least was not when compiling the view. The view of the investigator is more technical. It has for example *discussion/communication* as a concept but it also specifies that the discussion happens in the *staff room* and is *moderated*. *Discussion* has, however, been noted in two levels of abstractness as a part of two different entities.

The view of the investigator is missing the complete context of use. The designers knew a lot of the background of Opettaja.tv and YLE, and the users knew the importance of pupils. The users' elements are more abstract in average compared to investigator. The investigator has a separate entity called *concepts* which deliberately aims to have more abstract level but the elements of that entity are only a small part of the whole view. Users have almost half of their view in more abstract level, including elements such as *learning experiences and results* or *interaction (between teachers and students)*.

6 Discussion and Conclusions

The first goal of the study was to **discover or develop a method for breaking a product or service into elements** suitable for using them as a base for implementing the lead user method, and benchmarking supporting the method, in the development of an existing product or service. Was this goal achieved?

Although the view of the investigator is extensive and even has elements that were not discovered in either the user or the designer workshops, one could not be certain of successfully seeing the complete view of the service. If one were to conduct a similar tear down from the beginning, how should it be done? Of course, the view of both the investigator and P3D participants combined would be the most extensive. But with limited resources, one should use the P3D method. The view resulting from P3D contains the perspective of both users and designers. The investigator aimed for acquiring these perceptions too but that approach required several meetings, various information sources and different types of methods – in other words, a lot of scattered use of resources. Also, when aiming to discover those both perceptions, the investigator would still have missed a huge section of the user perception which was revealed by the P3D method. In addition to the original goals of this study, the P3D method resulted in interesting discovery concerning the user perception of a product or service concept that provides significant evidence of the value of the P3D method.

One of the original aims of P3D was to capture the perceptions of both users and designers – which it did. The original conception of the perceptions of the users and designers was that they would share a view, just looking at it from different perspectives and complementing the views of each other. It was assumed that the designers' perception would be formed by individual features of the product while users' perception would have corresponding incidents related to the use value and context of the service. However, in early stage of both P3D workshops the participants began showing clear signs, that the user's perception is not a clear counterpart of the designer's perception. The 3D model built by the users had several elements that had no counterpart in the designers' model since some of the elements portrayed matters that were not directly linked to the service at all. The user perception included several elements from outside

the use context covering a larger area of user's life than just the interaction with the service. The assumed perceptions and the actual perceptions are illustrated in Figure 20.

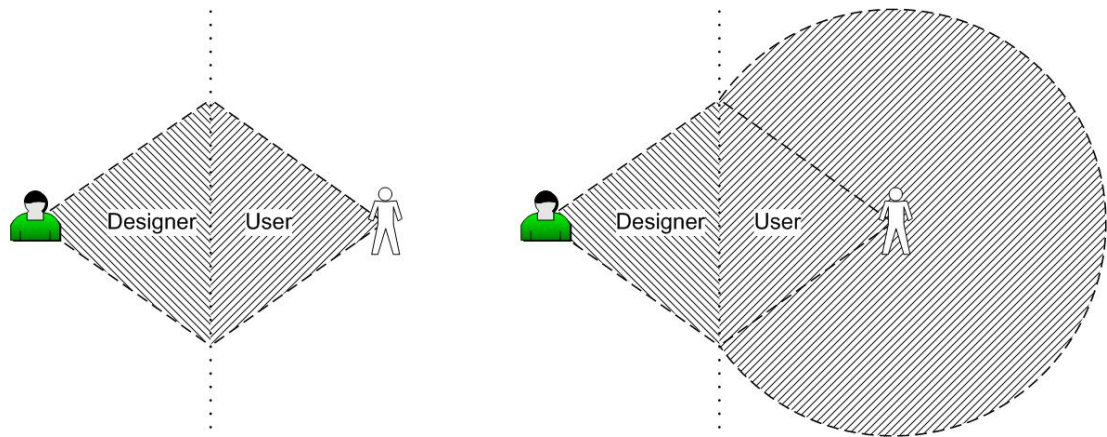


Figure 20 The assumed and the actual perceptions of users and designers

The discovery implies that the traditional product-centric thinking cannot provide sufficient understanding of the user's perception of a product or service. We saw that users, instead of focusing only on aspects and features that the designers saw as marginal, focused also on aspects the designers possibly did not realize even existed. Users have no reason to act in a way that would seem rational for the designers. User's perception of a product is not necessarily based on the product itself, but on loosely related issues, anything from a beautiful cashier or repulsive package to the conditions of the context of using the product. Users are not answering to the same questions the designers are posing. It is not a surprise that interpreting the thoughts of the users can be difficult.

Designers have their extended perception as well. The designers were able to describe the background of Opettaja.tv in more detail. Also the users realized that there are some external players around the service but their knowledge in this matter was limited compared to the designers. They also might have had details of the background which they still excluded since it was not important to them. In both cases, the designers have the responsibility for designing and these aspects will be taken into account anyway – whether the users know them or not.

As this study gathered its empiric evidence from a case of resigning a service for teachers, the background of the investigator should be taken into account. The

investigator has several hundred hours of teaching experience in elementary school and this might affect on the results of the investigator. If the investigator would not have had teaching experience, the results of the investigator would probably have been more concise. In other words, the gap between the results achieved with the methods of the investigator and with the P3D method is probably even greater, increasing the effectiveness of the P3D method.

Naturally one cannot be sure of the extensiveness of the results of the two P3D workshops. There are differences between different users as well. Two groups of users will most likely not build the same 3D model. For gaining even more extensive view in any similar project, there is a possibility of organizing more of these workshops or trying to facilitate larger workshops with more participants. Larger workshops would require some revising of the method and the workshop flow. The two organized workshops were a sufficient amount for providing the groundwork for implementing the lead user method and benchmarking in this particular case. However, more of P3D workshops should be organized to further develop the method. It would be interesting to see the differences between different user workshops. There may also be other stakeholders. In this case, parents of the pupils would be one example. One could consider what other perceptions could be captured.

The accessories used in modeling during the workshops (Figure 10) are another point of interest. The aim was to make them as little intimidating and challenging for the participants to use as possible. Based on the participants' feedback, this goal was achieved. The participants also stated that the use of physical materials made thoughts concrete and thus facilitated communication in the model building phase. *"In the middle of a conversation, you can easily get carried away and lose the track of your thoughts."* *"Now everything was concrete all the time, and ideas did not just vanish."* However, the wooden pawns' part in the accessories should still be revised. The wooden pawns played a major role in the user workshop where they were instantly chosen to act as pupils, forming the centre of the whole model. In the designer workshops they represented humans too. The wooden pawns might be guiding too much – they might be "too obvious". None of the other accessories have any clear form that could force thoughts to some specific direction. This depends also on the case. If the goal of the workshop would be breaking the business of an ice cream manufacturer into elements, the

cardboard cones might play a significant role. Similarly, it is natural for the wooden pawns to end up representing humans in a human-centered service. At the moment it seems that all the other accessories are generic enough excluding some specific cases like the ice cream manufacturer mentioned above. However, one could also ask, *should* the accessories be completely generic.

The Participatory 3D modeling method developed for the purpose proved its excellence in breaking Opettaja.tv into elements that the service comprises. However, the entities resulting from the P3D workshops need some revising before using them as a base for the lead user method or benchmarking. Some of the entities can be used while others cannot. The method succeeded in providing an extensive view to the service and revealing elements that would not have been discovered by the investigator. The P3D method was tested in redesigning a *service* even though the research conducted in this study had a strong emphasis on *product* development. Considering the successful performance of the method, it is clear that the engineering design emphasis did not hinder the performance in *service* design. Turning it backwards, the P3D is most likely to be suitable for redesigning *products* as well. However, there is a possibility that an already existing physical and tangible product might guide the modeling too much.

In addition to the possibility of using the P3D method in product development, the other possible appliances of the method should be considered as well. The method, as described in this study, aims to break down a product or service making it easier to understand it. Reversing the method might result in a useful tool in concept development for example. The goal, instead of tearing a product down, could be building a concept out of nothing using the same or similar accessories.

Another matter considering the future of the P3D method is its suitability for being the provider of the starting points (entities) for the lead user method and/or benchmarking. As pointed out, the entities could not be used as they were. In the Innope project, the final entities were formed by the project team using the results of the P3D method as a foundation. Some of the entities were used and some entities were formed by combining some elements and entities. The most crucial entities of Opettaja.tv were identified by the project team and were then confirmed by members responsible of the project at YLE's side. The method could be further developed by figuring out ways to guide the

creation of entities into more suitable form. The level of abstractness for example could be one guideline. Maybe there are some guiding questions the participants could be asked when forming the entities. This might not limit the creativity too much since the most creative phase, the model building, is over.

The tangible results of a P3D workshop are the 3D model and the grouped elements in form of post-it notes or in some similar form. Someone who is not present in the workshop would not understand the importance of some elements or entities to some or all participants just by inspecting the results. This is yet another aspect that could be further developed in the method. How to collect the special emphasis on some elements or entities? How to capture the feeling or atmosphere when building some parts of the model? In this case, emphasis, feeling and atmosphere were captured in video and audio recordings and transformed into more accessible form of quotations. Quoting or some other practice could be made a systematic part of the method.

Final proposition for further development of the P3D method is variations between group sizes and accessory sets. During this study there were two workshops organized with the same accessories. The method could be tested by organizing more workshops with the same accessories using participants with similar backgrounds and with varying backgrounds and by doing the same with different types of accessory sets. This kind of experimenting would help find the most effective combinations for future use of the method.

The second goal of this study was to **consider the possibilities of the lead user method and benchmarking supporting each other** through the P3D method presented in the study. Both approaches share the mindset of pursuing solutions developed by someone else or with the help of someone else. The lead user method aims to identify lead users in order to develop products with them, or to identify the solutions already developed by the lead users. Benchmarking aims to aid the development of solutions by comparing and adapting successful solutions developed somewhere else. As it was pointed out in chapter 3.4, the approaches have also similar first steps, in which identifying has a major role.

In contrast to benchmarking, the lead user method concentrates on identifying persons. Therefore the methods used and developed around the lead user method require reaction

from those persons while solutions acquired with benchmarking most likely will not react to stimulus caused by for example pyramiding, screening or broadcasting. Persons, either successfully identified lead users or persons contacted during the process, might also possess valuable information of existing solutions – similar information that is pursued in benchmarking. Both approaches already share some methods, such as surveys or questionnaires for example. Benchmarking could benefit from the networking approach often used in lead user projects. Also, when conducting pyramiding as part of any lead user process, why not bring additional questions about existing solutions to interviews conducted anyway?

The generic lead user process presented in chapter 2.3 comprises sequential steps. The trend and need identification takes place before identifying lead users. These steps could also be taken concurrently. Why not ask potential lead users for possible trends or ideas for analogous fields while identifying lead users?

The combined approach using the strengths of both lead user method and benchmarking could work when using the same methods simultaneously in going through both lead user and benchmarking process. The integrated method is illustrated in Figure 21 which uses the figure of von Hippel et al¹¹³, originally illustrating the differences of screening and pyramiding, as a foundation. The methods mentioned in the illustration (pyramiding, broadcasting and screening) are explained in chapter 2.3, except for the P3D method which is explained in the chapter 4.2. Specific starting points for pyramiding are defined with methods used in lead user processes but which are not included in this study. The P3D provides the fields or areas from where these starting points can be sought. In the case of Opettaja.tv for example, one of the fields that resulted from revising the P3D results, is *content* which has subfields such as *finding*, *producing*, *presenting* and *using*. The results of the integrated approach used in the Innope project are not a part of this study, but an example of one of the lead users identified during the project helps in understanding the big picture. A broadcast was sent to an online forum targeted for people interested in using social media in teaching. This online forum was found with methods not included in this study. The content of the broadcast aimed to get examples of nicely realized websites, designed or used for teaching purposes – in terms of content and usability. Someone reacted and answered to the thread, pointing to a blog of a

¹¹³ von Hippel, Franke & Prügl 2009

progressive school. The blog led to another nice solution and behind that solution there was a lead user, which was confirmed by interviewing him. Interestingly, a pyramiding sequence that was started later, from another starting point in the same field, led to the same social media centred online forum – among other solutions and persons. The illustration in Figure 21 can be further explained with the help of the following examples:

- a. Starting from the person (black dot) at the middle of the bottom of the leftmost pyramid we can see how, by networking, we can move around the field represented by the pyramid. Interviewing the first person guides to a solution. In some cases it might be possible to continue networking from a solution. This requires some proactive research. A website for example might have the name of person behind a solution. This person can again be interviewed and after continuing the pyramiding we are finally hinted of an analogous field where we eventually identify a lead user the top of the middle pyramid.
- b. The leftmost broadcasting effort does not get any reaction. Maybe it did not hit any suitable persons or persons just did not react to broadcasting. This type of unsuccessful broadcasting is naturally possible.
- c. The broadcasting effort on the right seems to be fruitful. The broadcasting hits someone who possesses information of both promising person and nice solution. However, neither one of them was able to point any new direction. The broadcasting also identified a lead user at the top of the rightmost pyramid. Since the lead user was identified with broadcasting, the lead user had to react to it – broadcasting requires a reaction.
- d. The screening did not seem to identify any lead users or persons who would be able to give any new leads. It hit a nice but not superior solution, revealed by a person.

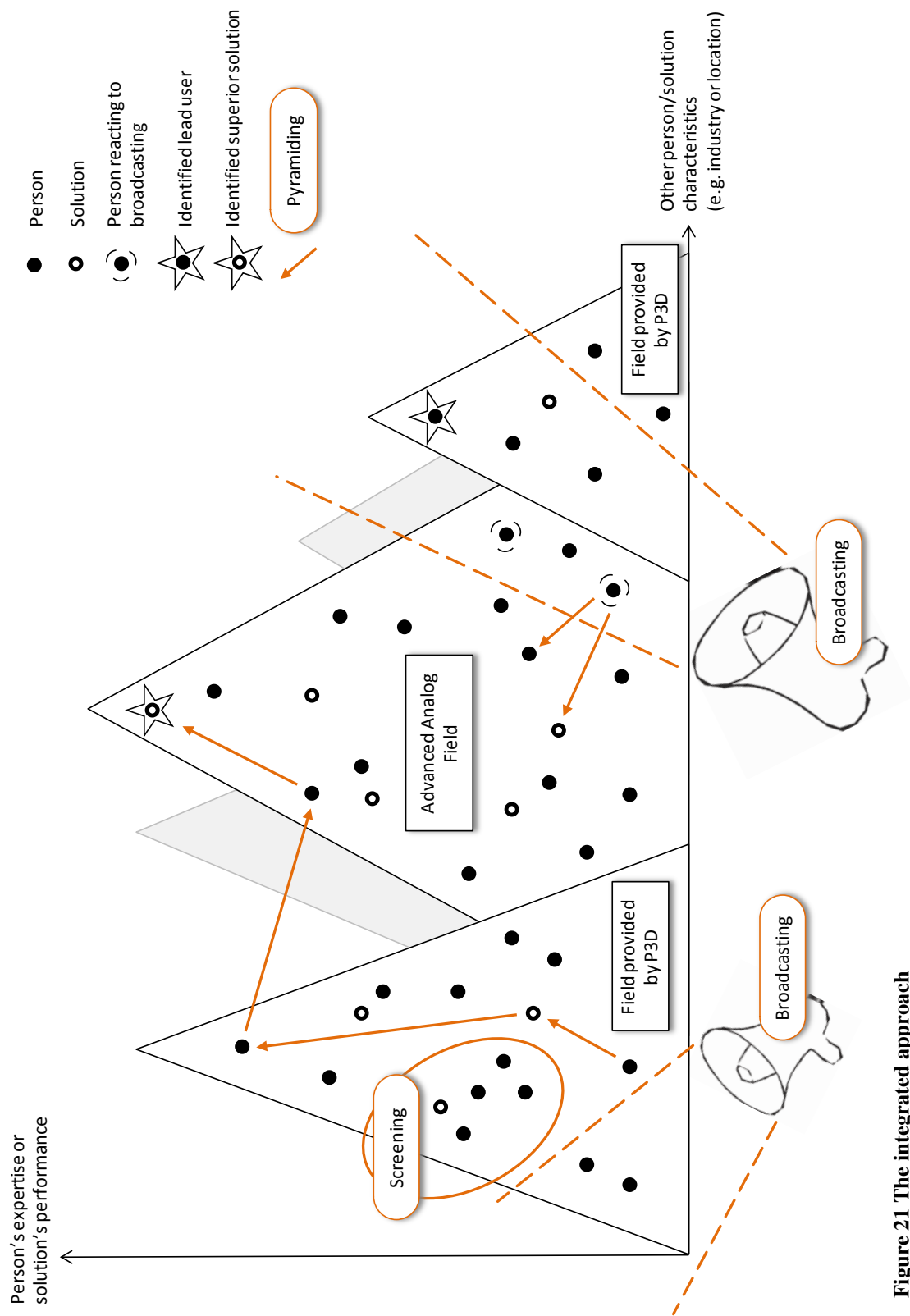


Figure 21 The integrated approach

As already pointed out, the pyramids at the left and at the right (Figure 21) represent fields resulting from a perfected P3D method. The P3D, as it is used in this study, can be a part of the integrated approach only when the task is to redesign something. If something is to be torn down, it has to exist first. One of the strengths of the lead user method is the possibility to come up with new, breakthrough, products^{114,115}. The integrated approach proposed here is more effective when improving an existing product or service, when compared to a plain lead user approach. After all, learning from something already existing is the idea behind benchmarking – the approach that has been brought to support the lead user approach, and vice versa. However, there is no reason why it could not be used in any lead user project. If the resources allow asking a few extra questions about existing products, the gathered extra information might prove useful. The possibilities of the lead user method and benchmarking supporting each other are promising.

During this study it became clear that the generic lead user process is merely a guide. Only in a perfect world would it be possible to just accurately follow a set of predefined steps. The generic process has to be altered according to the needs. It would also be unwise to follow the process strictly ignoring all sources of information that were not found by the methods used. Like said, lead user method and benchmarking share the mindset of acquiring solutions from outside. This mindset should be further expanded and during any process it would be recommended to absorb random information, with certain criticism of course, from various sources and to avoid the attitude of not approving something which is not developed by oneself or in the house. Starting points for pyramiding method, for example, might occur anywhere.

Considering the suitability of the lead user method for this case, it became clear that even though any particular method might seem extremely powerful, it might not be the best one for some specific purpose. Lead user process is demanding and requires a lot of effort. The strength of the approach is in generating breakthroughs. It is suitable for developing improvements as well but in this particular case it seemed like a method, although highly useful, also almost too extensive. The power of the lead user method is indisputable when developing breakthrough products or new product lines.

¹¹⁴ von Hippel 1986

¹¹⁵ von Hippel 2005

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Appendices

Appendix 1: Accessories used in Participatory 3D modeling workshops

Page 1/5 of the Accessories

Wooden pawn

Measurements

small h=47 mm, d=22 mm

big h=60 mm, d=29 mm

Quantity

small 4

big 4



Straw

Measurements

h=210 mm, d=5 mm

Quantity

pink 15

yellow 15

orange 15

green 15



Wooden stick

Measurements

h=300 mm, d=6 mm

Quantity

10



Page 2/5 of the Accessories

Wooden straw

Measurements

$h=300$ mm, $d=3$ mm

Quantity

20-30



Paper string

Measurements

approx. 10 m

Quantity

-



Sticker sheets

Measurements

approx. $h=10-40$ mm

Quantity

numbers, letters, stars:
1?sheet with 20?stickers of
each



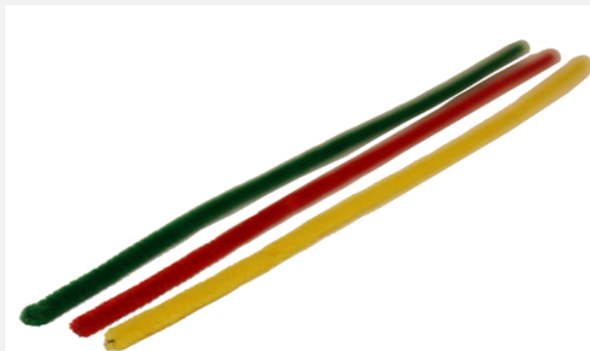
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Pipe cleaner

Measurements
h=300 mm

Quantity

red	15
yellow	15
green	15



Scissors

Measurements
-

Quantity
3



Marker (black)

Measurements
sharp pointed

Quantity
one per participant



Page 4/5 of the Accessories

Modeling clay

Measurements

-

Quantity

red	60 gr
orange	60 gr
green	60 gr
blue	60 gr
black	60 gr
yellow	60 gr
white	60 gr
grey	60 gr



Post-it -notes

Measurements

-

Quantity

pink	5 stacks
yellow	5 stacks



Transparent adhesive tape

Measurements

-

Quantity

one roll



Hollow cardboard cone	
Measurements h=130 mm, d=70 mm	
Quantity 7	